CEMENT-LOCK® TECHNOLOGY DEMONSTRATION PLANT

Endesco Clean Harbors LLC

Andersen 2000 Inc Project Reference #I-8427-1148

CLASSROOM TRAINING SESSION

Syllabus / Schedule

Handout

September 3 – 4, 2003

Endesco Clean Harbors LLC
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CLASSROOM TRAINING SESSION

September 3 – 4, 2003

WEDNESDAY, SEPTEMBER 3

1. INTRODUCTION **8:00 a.m. – 8:15 a.m.**
- A. Training Program Review

2. ECOMELT PROCESS REVIEW/DESCRIPTION **8:15 a.m. – 8:45 a.m.**

3. SAFETY PRECAUTIONS (II)* **8:45 a.m. – 9:15 a.m.**
- A,B,C. Safety Precautions
- D. Hardware Inspection & Conditions
- E. Utilities Availability
- F. Controls & Alarms
- G. Burner Safeties
- H. Solids Conveying System

4. PROCESS OVERVIEW (III) **9:15 a.m. – 10:15 a.m.**
- A. Sediment Processing
- B. Primary (Materials) Treatment
  - a. Feed System
  - b. Primary Treatment Unit (PTU)
  - c. Ecomelt Quench System and Granulator
- C. Secondary (Gas) Treatment
  - a. Secondary Treatment Unit (STU)
  - b. Evaporative Gas Cooling Chamber/Flue Gas Quench System
  - c. Lime Injection/Baghouse System
  - d. Activated Carbon Adsorption Bed
  - e. Draft System
- D. Processed Materials
- E. Safety Equipment

BREAK **10:15 a.m. – 10:30 a.m.**

5. MAJOR SYSTEM COMPONENT REVIEW (IV) **10:30 a.m. – 12:00 p.m.**
- Sediment storage bin
- Alternate feed bin
- Transfer conveyor (C-102)
- Transfer conveyor (C-101)
- Weigh screw conveyor
- Modifier #1 hopper
- Vent filter
- Screw conveyor for modifier #1 material
- Modifier #2 hopper
- Bucket elevator

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MAJOR SYSTEM COMPONENT REVIEW
(Continued)

- Sediment/modifier mixer
- Water cooled auger/screw feeder
- Ecomelt generator
- Secondary combustion chamber/afterburner
- Gas fired burners
- Ecomelt discharge system
- Granulator with recirculation tank and water pump
- Wet granulated Ecomelt conveyor and rotary feeder
- Quencher and double tipping valve
- Quencher water pump
- Quencher water tank
- Stack cap and accumulator
- Lime hopper
- Vent filter
- Lime eductor blower

LUNCH **12:00 p.m. – 12:30 p.m.**

- Baghouse & rotary airlock **12:30 p.m. – 2:00 p.m.**
- Activated carbon bed
- Air compressor
- Surge tank
- Induced draft fan
- Exhaust stack
- Ecomelt dryer with burner
- Rotary feeder
- Dried Ecomelt conveyor
- Dried Ecomelt bucket elevator
- Ecomelt hopper
- Ecomelt product conveyor
- Dryer cyclone separator and dust discharge rotary feeder
- Bag filter
- Ecomelt dryer induced draft fan
- Vent stack
- Continuous emissions monitoring system

BREAK **2:00 p.m. – 2:15 p.m.**

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6. PLANT START-UP PROCEDURES (VI) **2:15 p.m. – 4:00 p.m.**

A. General
B. Preparation for Initial Startup
   a. Water tanks
   b. Air compressor and instrument air dryer
   c. Ecomelt generator
   d. Quencher baghouse, activated carbon bed, I.D. fan
   e. Continuous emissions monitor (CEM)
   f. Ecomelt dryer
   g. Ecomelt product system
   h. Lime eductor system
   i. Combustion air and nose cooling blowers
   j. Tank filling and leak checking
   k. Bin vent filters
   l. Baghouse and bag filter
   m. Modifier 1 & 2 feed systems
   n. Raw sediment feed systems

C. First Time Startup and Refractory Curing Procedures
   o. Scrubbing system preparation
   p. Refractory curing precautions
   q. Ecomelt generator system preparation
   r. Ecomelt dryer system refractory curing
   s. Raw sediment feed

D. Normal System Start-up Procedures
   t. Air compressor and instrument air dryer
   u. Scrubbing system preparation
   v. Ecomelt generator system preparation
   w. Ecomelt generator warm-up
   x. Ecomelt dryer system warm-up
   y. Raw sediment feed

7. OPERATIONAL GUIDELINE REVIEW (VII) **4:00 p.m. – 6:00 p.m.**

1. Operating Temperature Ranges
2. Material Processing Rates
3. Feed Rate Controller
4. Beginning Feed to the Ecomelt Generator
5. Ecomelt Generator Rotational Speed
6. Ecomelt Warm-up
7. Ecomelt Draft
8. Material Discharge Temperature
9. Ecomelt Quencher and Granulator
10. Secondary Combustion Chamber Warm-up

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OPERATIONAL GUIDELINE REVIEW (Continued)

11. Secondary Combustion Chamber Temperature Variations
12. Oxygen/Contaminant Oxidation
13. Quencher Exit Temperature
14. Quencher Nozzle Inspection
15. Baghouse Inlet Temperature
16. Baghouse Exit Temperature
17. Baghouse Pressure Differential
18. Testing for Baghouse Leaks
19. Lime Injection System
20. Activated Carbon Bed
21. Air Compressor

THURSDAY, SEPTEMBER 4

1. SHUTDOWN PROCEDURES (VIII) — **8:00 a.m. – 9:30 a.m.**

- A. Normal Shutdown
- B. Power Failure Shutdown
- C. Alarm Shutdown
- D. Emergency Stop

2. SAFETY (IX) — **9:30 a.m. – 9:45 a.m.**

3. EQUIPMENT LUBRICATION (X) — **9:45 a.m. – 10:00 a.m.**

- A. Importance of Lubrication
- B. Anti-friction Bearings
- C. Local Assistance
- D. General Lubrication Procedures
- E. Access to Lubrication Points

4. KILN AND SUPPORT TRUNNION ALIGNMENT (XI) — **10:00 a.m. – 10:15 a.m.**

- A. Introduction
- B. Components
- C. Trunnion Design
- D. Setting the Flame and Drum
- E. Trunnion Adjustments

BREAK — **10:15 a.m. – 10:30 a.m.**

5. DRIVE BELTS (XII) — **10:30 a.m. – 10:45 a.m.**

- A. Adjusting V-belt Tension
- B. Adjusting 3V-5V-8V Sections

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6.	**CHAINS AND SPROCKETS (XIII)**	**10:45 a.m. – 11:00 a.m.**
	A. Drive Chains	
	B. Ecomelt Generator Drive Chain Lubrication	
	C. Drive Chain Elongation	
	D. Drive Chain Breakage	
	E. Ecomelt Generator Drive Sprocket	
	F. Chain Tension	
7.	**I.D. FAN AND BLOWERS (XIV)**	**11:00 a.m. – 11:15 a.m.**
	A. Fan Inspection	
	B. Fan Vibration	
	C. Other Sources of Vibration	
	D. Prolonged Shutdown	
8.	**EQUIPMENT INSPECTION AND MAINTENANCE (XV)**	**11:15 a.m. – 12:15 p.m.**
	A. Daily Maintenance	
	B. Weekly Maintenance	
	C. Monthly Maintenance	
	D. Annual Maintenance	
LUNCH		**12:15 p.m. – 1:00 p.m.**
9.	**TROUBLESHOOTING (XVI)**	**1:00 p.m. – 2:00 p.m.**
	A. General	
	B. Feed System	
	C. Conveyor	
	D. Ecomelt Generator	
	E. Material Discharge System	
	F. Secondary Chamber Combustion	
	G. Flue Gas Quencher	
	H. Baghouse	
	I. Stack Gas Discharge	
10.	**QUESTIONS**	**2:00 p.m. – 2:30 p.m.**

TRAINING SESSION CONCLUDED

*Roman numerals refer to sections in the Cement-Lock System Operating & Maintenance manual.

II. NOTICE AND SAFETY PRECAUTIONS

A. Introduction

This operating manual presents information that will help you to properly operate and care for the equipment. Study its contents carefully. These units will provide good service and continued operation if the operation and maintenance instructions are followed. No attempt to operate the unit should be made until the principles of operation for all of the components are thoroughly understood.

Andersen 2000's equipment is designed and engineered to give long life and excellent service on the job. The electrical and mechanical components were chosen because of their known ability to perform. However, in order to assure optimum service life, proper operating techniques and maintenance procedures must be followed at all times. Also, although these components provide a high degree of protection and safety, operation of the equipment is not to be considered free from all the dangers and hazards inherent in the handling and firing of fuel and waste.

Any automatic features included in the design do not relieve the attendants from being attentive and responsible in the operation of the equipment. Such features merely free them from certain repetitive activities and provide more time for proper maintenance of the equipment.

It is solely the owner's responsibility to properly operate and maintain the equipment. No amount of written instructions can replace intelligent thinking and reasoning, and this manual is not intended to relieve the operating personnel of the responsibility of proper operation and maintenance.

It is recommended that a system operational log or record be maintained. Recording of daily, weekly, monthly, and yearly maintenance activities, and recording of any unusual operation will serve as a valuable guide to any necessary investigation associated with resolution of operational or functional problems.

B. Notice

The owner, its agents and employees who operate and maintain this equipment should be aware that this manual includes information that is proprietary to Andersen 2000 Inc. Some or all may be protected by U.S. or foreign patents. The drawings and technical information incorporated in this manual are not to be used or reproduced without the written consent of Andersen 2000 Inc.

Satisfactory performance of the equipment and systems provided for this project will depend upon compliance with the design parameters and information contained in this manual. Improper operation or disregard of the instructions and design criteria called out in the

various sections of this manual will compromise the system performance, diminish its life and even at times endanger operations or maintenance personnel.

Proper system performance is based solely on the operating parameters stated in this manual. Deviations from these parameters or making system modifications/adjustments without Andersen 2000's approval may result in malfunctions or permanent damage to the equipment. Andersen 2000 cannot be held liable for any equipment or system performance problems under such circumstances.

IMPORTANT SAFETY NOTICE!

READ THIS BEFORE READING FURTHER OR OPERATING EQUIPMENT

C. Safety Precautions

Safety Program

The owners and operators of this equipment are responsible for establishing an effective safety program that is consistent with good management practices and any laws, regulations, or ordinances that may apply. The specific safety, precautions, and hazards associated with the equipment operation and the general work area must be effectively communicated to all personnel involved with the equipment. A common understanding of these precautions and hazards must be obtained by all personnel to assure continuity in maintaining a safe work place environment.

Andersen 2000 insists that its customers follow lockout/tag out safety procedures by using lockable valve(s) on make up water line(s), lockable valve(s) on compressed air line(s), lockable valve(s) on fuel line(s) and lockable disconnect(s) for all electrical supplies to Andersen equipment. Andersen disclaims any responsibility for any accidents resulting from customer failure to install and use this safety equipment.

A careful equipment operator is the key to safe job performance and the best insurance against preventing a system malfunction or serious accident. Operator safety and the safety of others depend upon reasonable care and judgment in the operation of the equipment. Most accidents are caused by failure to observe simple safety rules and precautions. Be aware of what is going on around the work area. Learn to recognize hazards before they become accidents and to avoid setting up dangerous situations.

General Safety Precautions

The purpose of these safety precautions is to make all personnel aware of the general hazards and dangerous situations that exist around the equipment and the work area.

1. Read and understand each of the cautions, warnings, and instructions in the operator's manual and on signs fixed to the equipment.

2. Inspect all equipment components before each operating shift to ensure that no parts are damaged or suspected of being damaged. Repair or replace damaged parts before starting or operating the equipment.

3. Check for warning tags and locks on equipment components or controls before starting or operating the equipment.

4. Do not allow unskilled persons to start or operate any equipment without the proper supervision of a skilled operator.

5. Never leave equipment controls unattended. Always have a qualified operator relieve you if you must leave.

6. When starting equipment, follow the manufacturers recommended starting sequence.

7. During startup and while the equipment is operating, be alert for improper readings, visual defects, odors or unusual sounds that could be a warning of a potential hazard. Shut down equipment immediately, following established shutdown procedures, if any unsafe condition

8. Do not work on equipment while it is in operation. Shut down, lockout, and tag all machine controls before performing any inspection, maintenance, lubrication or adjustment. Perform all required inspection, maintenance, lubrication or adjustments before starting or operating the equipment, or after the equipment is shut down.

9. Perform all inspection, maintenance, lubrication, and adjustment procedures with caution and in accordance with the manufacturer's recommended procedure.

10. Ensure that all guards and safety devices are properly installed and in working order before starting or operating the equipment.

11. Do not allow unauthorized personnel in or around the work area and equipment. Know who is in your work area at all times. Use a head count when necessary.

12. Refractory that has not been cured can release moisture explosively in the form of steam and debris from broken refractory if exposed to excess temperature or to rapid heat-up. If the system has any uncured refractory, it is necessary to cure it in exact accordance with instructions in this manual before starting up this system. Failure to do so will result in serious equipment damage and possible injury to operating personnel. Andersen disclaims any responsibility for damage or injury resulting from failure to cure or from improper curing of any refractory in the system.

13. Fuel can leak past damaged valves or burners in any incinerator system. Fumes from such leaking fuel can accumulate inside the rotary kiln melter and ignite explosively during system start-up. The burner safety systems are designed to prevent any such occurrence, but if any safeties have been bypassed, damaged or defeated, an extremely unsafe and explosive condition could develop rapidly. Do not operate any portion of this system if any safeties have been damaged, defeated or altered in any way and do not operate this system if you have not been properly trained. Do NOT depend on computerized controls to protect you from malfunctions.

Specific Safety Precautions

Because of the nature of the equipment, safety precautions cannot be overemphasized. It is essential to read and understand the following safety precautions before attempting to operate the equipment.

FAILURE TO HEED TO THESE PRECAUTIONS MAY RESULT IN SERIOUS PERSONAL INJURY OR DEATH

- Complete understanding of this manual is required before attempting to operate or maintain this equipment.
- Use safe working habits at all times.
- Never open any access door on the system while the incinerator is in operation.
- Stay clear of conveyors as they may start automatically. If necessary to repair or adjust any of the equipment, place the power switch in the off position and lock and tag the power disconnect switch.
- Do not rely on the hydraulic system to hold charge doors in the open position during inspection or maintenance. Securely block the doors open so they cannot close.
- Keep clear of all moving equipment and pinch points. Do not wear loose fitting clothing that can become caught in moving parts.
- Never enter the chambers of mechanical loaders, waste feed systems, ash conveyors, the incinerator or other equipment without first taking the normally recognized safety precautions of de-energizing and locking out all power sources. Also, all fuel supplies should be locked out as well.
- Do not enter any vessel unless all access doors are open and a positive ventilation system has been installed. Check for appropriate oxygen levels within the equipment and do not enter any vessel without checking for combustible or toxic gases. Work of this type should never be done alone, but always in the presence of a second individual who is familiar with the equipment control circuits involved and who is

also able to implement safety procedures, including rescue from the vessel, if required.

- Make sure all safety systems are operable (flame detectors, water sprays, emergency lockout devices and emergency stop switches) which have been provided as a part of the equipment system.

D. Hardware Inspection And Conditions For Operation

A thorough inspection of the equipment should be conducted before the equipment is started. This should include, but not necessarily be limited to, the following:

1. Primary Combustion Chamber (Ecomelt Generator R-201) and Secondary Combustion Chamber (Afterburner R-202).

The primary combustion chamber, R-201, is a refractory-lined rotary kiln. The secondary combustion chamber, R-202, is a refractory-lined horizontal afterburner with a natural-gas-fired burner.

There are numerous safety and burner interlocks on the kiln and afterburner units. Never bypass any of these interlocks. Caution should always be exercised in inspecting the hardware of the system. All access doors should be closed and secured. All the refractory lined breaching should be inspected for spalling, cracking and any other refractory damage.

The main shutoff fuel valves (isolation valves) on both the main burners and the pilot burners should be in the open position. **NOTE:** these are not the automatic burner valves. These are the isolation valves installed to allow maintenance and service of the burners.

The primary and secondary combustion chambers are both more fully described in the Equipment Specification section of this manual.

2. Air Pollution Control Equipment

The air pollution control system includes non-metallic components, baghouse filter media, which is not temperature resistant. The temperature limitation for the filter elements is 550°F or 288°C. Obviously, the outlet gas from the secondary combustion chamber (R-202) is considerably higher in temperature than the temperature limitation of the baghouse components. Therefore, it is essential that the quench water pump (P-301) and quench (Z-301) be activated and that liquid is flowing at an adequate rate before hot gas is admitted. It is essential that the operator checks all valve settings and pump operating conditions to insure that there is adequate liquid flow.

The system is equipped with temperature monitoring devices that activate solenoid valves that bleed in air to cool the gases in the event temperature exceeds 400°F. These temperature switches must not be disabled.

E. Utilities Availability

The rotary kiln melter system requires electrical power, instrument quality air, and natural gas and water supply systems to enable continuous operation. Interruption of any of these services may be detrimental to the system. The system has been designed to be fail-safe. Disabling or bypassing any of these systems is strictly forbidden. For example, if electrical power failure occurs, all of the controls are set to fail to a safe position.

F. Controls And Alarms

The rotary kiln melter system is a rather complex system equipped with a number of alarms to caution the operator about component parts of the system that need attention. It is important that these alarms are not bypassed. It is also important that all alarms be tested and verified at least weekly to insure that they are properly operational.

This system is also equipped with a very sophisticated controls system to control appropriate variables and to activate alarm and safety functions when necessary. The software and logic used in these controls must not be changed without consulting Andersen 2000.

G. Burner Safeties

Each burner has an appropriate burner safety system connected to it. Each burner will always have a low fuel pressure switch, a fan proving switch to prove operation of the combustion air fan, and a flame detector. The pressure switches must be calibrated at least annually. Under no conditions should the burners be operated if the flame detector is not functioning. Under no conditions should any of the burners be manually ignited. It is of critical importance that before any burner is started, a purge cycle takes place. This purge cycle involves blowing combustion air through the burner without fuel to "sweep" out any possible unburned fuel accumulations before any ignition is started. The burner safety controls accomplish this through a pre-programmed purge mode before the pilot flame is lit and before the main burner is turned on. **You** should refer to the vendor literature on the burners and burner safety control systems included in the Vendor Manual before attempting to operate any of the burners in the system. If any of the burner safeties furnished with this system are disabled, you automatically void any warranties on any of the component parts in the system and you also jeopardize the safety of the operators of the system.

H. Solids Conveying Systems

The rotary kiln melter system utilizes a number of product removal systems and conveyors to move solids. These systems must be well maintained at all times including lubrication of gears, drives and idlers and proper alignment and tensions. DO NOT attempt to adjust, service or repair conveyor systems while the unit(s) is in operation. Refer to the appropriate sections of the Vendor Manual for specifics with regard to conveyor installation, maintenance or repairs.

III. PROCESS SPECIFICATIONS

SEDIMENT PROCESSING

The system described in this document has been designed and constructed to treat contaminated materials dredged from harbors and rivers. Key design considerations include the ability for complete control of operational parameters in each component to efficiently tune the system for the most effective operation for specific contaminant removal and treatment.

The *Primary Treatment Unit* (or Ecomelt Generator) system consists of three component sub-systems. These components are; the material feed system, PTU (rotary drum), and the Ecomelt quench system. The material feed system equipment serves primarily to feed the sediment and modifiers into the thermal system for processing. The PTU heats the materials to the required processing / melting temperature and maintains the materials at the elevated temperature for a particular time period. The treated material quench system serves to cool the materials by direct water addition and mixing.

The gases produced in the PTU are treated by the *Secondary Treatment* system. Gases exiting the STU are cooled in a Quench Chamber prior to the baghouse. A baghouse is included for removal of particulates from the gas stream before the gases are exhausted to the Activated Carbon bed and subsequently to the atmosphere. Particulates captured in the baghouse are conveyed by a rotary feeder to a discharge bin (provided by others). An induced draft (I.D.) fan is located downstream of the carbon bed and serves as the mechanism to maintain flow throughout the system.

The system is versatile to allow the processing parameters to be established for individual remediation projects. The primary treatment unit should be operated at temperatures that prove sufficient for achieving the particular material treatment standards that are required. The gas treatment unit should be operated within a temperature range sufficient for the required destruction efficiency for the particular contaminants involved. Oxygen levels of the gas streams in the various components must be maintained to assure proper fuel combustion in the burners as well as oxidation of the contaminants. When the system is operated properly, the stack gas discharge contains a uniform oxygen content with minimal total combustibles and/or carbon monoxide. Burner and control adjustments are to be performed as necessary to maintain the required operational parameters.

The treated material leaves the Ecomelt Generator and is fed into the Ecomelt Quencher and the Granulator for cooling. The wet product is fed into the Ecomelt Dryer via the Wet Granulated Ecomelt Conveyor. The dry product is fed to the Ecomelt hopper via the Dried Ecomelt Conveyor and the Ecomelt Bucket Elevator. The gases from the Ecomelt Dryer are ducted to the Dryer Cyclone Separator and Bag Filter for removal of any particulates. The clean gases are vented to the atmosphere via the induced draft fan system.

The Ecomelt System will produce cleaned, processed materials as the primary product. This material will exit the system and is stored for subsequent distribution in the Ecomelt Hopper.

The drawing entitled Flow Diagram (Drawing 1148-3000) depicts the process as described including additional details of process interconnections with material and gas flow paths. Drawings 1148-3001, 1148-3002 and 1148-3003 are the rotary kiln melter system heat and mass balance sheets.

PRIMARY (MATERIALS) TREATMENT

The primary material treatment system consists of three component sub-systems which are; material feed system, PTU (rotary drum), and the treated material quench system. The process requirements for each of these components are identified below:

Feed System

The material feed unit is designed to receive the dredged sediment into the thermal treatment process while monitoring and controlling feed rates while adding modifiers. This is accomplished by a series of feed bins, feed conveyors, modifier hoppers, weigh screw feeders and mixing conveyor.

Primary Treatment Unit (PTU)

The PTU is a rotary drum in which contaminated materials are heated to a specific temperature at which the contaminants become vaporized and transfer to the PTU gas stream. Heat is provided by the burner system which utilizes natural gas to produce a flame. The burner system is designed with the ability of adding air to control the temperature of the combustion products from the fuel burning process. The flame supplies energy to the materials by radiation and conductive heat transfer. The chamber is fed on a continuous basis from the feed system. Once the sediment and modifier mixture is introduced into the drum, the drum functions to convey materials away from the inlet and into the burner zone. Once the mixture reaches the targeted processing temperature, it melts completely. The rotational speed of the chamber can be varied to alter retention time of the materials based on contaminant type and specific processing conditions. The material processing rate is directly related to the drum volume and varies with moisture content and treatment temperatures as well as contaminant type and concentration.

Ecomelt Quench System and Granulator

The molten material will be conveyed by the combination of kiln slope and rotation to the rear of the rotary kiln where via gravity it will be discharged into a refractory-lined chamber where it will be contacted by water sprays prior to falling into the wet Ecomelt conveyor. In order to assure that the molten material is free flowing until contacted by the water sprays, a 1.5 MM Btu/hr packaged burner system is incorporated into this discharge section of the rotary kiln melter system.

After being contacted with water sprays in the discharge section of the rotary kiln, the Ecomelt material will fall into a wet-type, drag conveyor for delivery to the Ecomelt transfer screw conveyor and subsequently the Ecomelt Dryer. The wet-type drag conveyor is provided with a 2 HP motor and gear drive as well as a 150 gpm, 40 psi, 7.5 HP, 3600 rpm cast iron pump to provide cooling water to the Ecomelt discharge section of the rotary kiln.

SECONDARY (GAS) TREATMENT

The gases leaving the PTU are treated by a Secondary Combustion Chamber, emergency bypass stack, flue gas quench, lime feed system, baghouse and activated carbon bed.

Secondary Treatment Unit (STU)

The STU is a thermal oxidizer designed as a horizontal cylindrical vessel lined with insulating refractory suitable for operational temperatures. A direct-fired burner supplies supplemental energy to maintain the desired outlet temperature of the gases. The function of the STU is to provide intimate flame contact with the gases, elevate the gas temperature to the targeted operational temperature, and provide retention of these gases within the chamber. This is based on estimated operational parameters of 2550°F at 2 seconds retention time for the gases. The gas volume entering the chamber along with the anticipated operational temperature and excess oxygen level is the basis for the size of the unit. The STU burner blower provides combustion air as well as the remaining air needed for oxidation of the contaminants. The system must be operated under this basis.

Evaporative Gas Cooling Chamber/Flue Gas Quench System

The gases from the STU must be cooled to a temperature that is suitable for the baghouse. This is accomplished by a vertical gas cooling chamber that reduces the temperature of the STU exhaust gases. The system operates by spraying a controlled volume of atomized water into the gas stream. The volume of atomized water is modulated according to the baghouse inlet gas temperature. As this temperature changes, the volume of cooling water is regulated to maintain the baghouse gas inlet temperature at 350°F or below to avoid damage to the baghouse filters.

Lime Injection/Baghouse System

A pulse-jet fabric filter collector has been provided for particulate filtration. The system includes lime injection (for acid gas removal) upstream of the particulate filtration system. The baghouse contains bags comprised of filter material through which the process gases pass. Dust is collected on the outside surface of the filter bags. This dust is periodically removed by a compressed air pulse-jet system which is operated to maintain the recommended operating pressure drop across the baghouse tube-sheet. The targeted operational temperature is 350°F. As dust is continuously removed from the exhaust gas stream inside the baghouse, it is collected in the baghouse hopper. The fines are then transferred by a rotary feeder to a discharge point for collection by others.

Activated Carbon Adsorption Bed

The activated carbon bed is an oblong vessel constructed of ¼" thick carbon steel. The vessel has been constructed with two, 2' thick layers (beds) of activated carbon. Each bed receives one half of the process gas flow. The activated carbon is "NORIT RBHG 4". NORIT RBHG 4 is a sulfur-impregnated steam activated extruded carbon. It is especially developed for the removal of mercury vapors from natural gas, air, hydrogen and other gases. It is impregnated in a special way with a sulphur component that forms with mercury vapor stable, non-volatile mercuric sulfide. It is based on a highly porous extruded carbon.

Each bed has been supplied with four temperature switches used to detect a fire in the bed. In the event of a high temperature excursion, a water deluge system is activated.

Draft System

The system includes the induced draft (I.D.) fan with flow damper to modulate and control the gas flow. The I.D. fan pulls the process gases through the entire system and pushes the treated gases out the stack. The gas flowrate is controlled by monitoring the internal pressure of the PTU near the PTU burner. As this pressure changes, the draft fan damper is adjusted to maintain uniform draft at the PTU feed end.

PROCESSED MATERIALS

The system will produce remediated, processed materials as the primary product. This material will exit the system and will be conveyed to a clean material storage hopper.

SAFETY EQUIPMENT

Safety systems are an integral part of the plant controlling and monitoring equipment. Both the PTU and STU burners include automatic control systems with high temperature shut-down capabilities. When activated, these limit systems will result in automatic shut-down of the burner system. The system will activate if the exit gas temperature of either the primary chamber, secondary chamber or other components exceeds preset limits. Burners are designed with the capability to modulate down to a very low firing rate to compensate for the contaminated materials. Burners include ultra-violet (UV) flame scanners as part of the burner safety systems which will shut down the burners and prevent fuel introduction if verification of flame is not confirmed. Fuel pressure safety switches and a timed purge cycle are also built into the burner control equipment.

The feed conveyor system is equipped with local stop cables mounted along the conveyor frame. This cable will stop the movement of the conveyor when tripped. The cables must be tripped manually when needed. These stop devices are intended to be used anytime a situation exists where personnel must access areas near the moving conveyors and prior to performing any type of maintenance in these areas.

Caged ladders, platforms with toe-plates and handrails are provided at certain locations throughout the system. These items are provided to promote personnel safety when accessing the equipment.

Other equipment for personnel safety should be used and incorporated into the system personnel safety program (i.e., fall harnesses, protective clothing, etc.) as required per local codes/regulations by the customer.

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Any automatic features included in the design do not relieve the attendants from being attentive and responsible in the operation of the equipment. Such features merely free them from certain repetitive activities and provide more time for proper maintenance of the equipment.

It is solely the owner's responsibility to properly operate and maintain the equipment. No amount of written instructions can replace intelligent thinking and reasoning, and this manual is not intended to relieve the operating personnel of the responsibility of proper operation and maintenance.

It is recommended that a system operational log or record be maintained. Recording of daily, weekly, monthly, and yearly maintenance activities, and recording of any unusual operation will serve as a valuable guide to any necessary investigation associated with resolution of operational or functional problems.

B. Notice

The owner, its agents and employees who operate and maintain this equipment should be aware that this manual includes information that is proprietary to Andersen 2000 Inc. Some or all may be protected by U.S. or foreign patents. The drawings and technical information incorporated in this manual are not to be used or reproduced without the written consent of Andersen 2000 Inc.

Satisfactory performance of the equipment and systems provided for this project will depend upon compliance with the design parameters and information contained in this manual. Improper operation or disregard of the instructions and design criteria called out in the

various sections of this manual will compromise the system performance, diminish its life and even at times endanger operations or maintenance personnel.

Proper system performance is based solely on the operating parameters stated in this manual. Deviations from these parameters or making system modifications/adjustments without Andersen 2000's approval may result in malfunctions or permanent damage to the equipment. Andersen 2000 cannot be held liable for any equipment or system performance problems under such circumstances.

IMPORTANT SAFETY NOTICE!

READ THIS BEFORE READING FURTHER OR OPERATING EQUIPMENT

C. Safety Precautions

Safety Program

The owners and operators of this equipment are responsible for establishing an effective safety program that is consistent with good management practices and any laws, regulations, or ordinances that may apply. The specific safety, precautions, and hazards associated with the equipment operation and the general work area must be effectively communicated to all personnel involved with the equipment. A common understanding of these precautions and hazards must be obtained by all personnel to assure continuity in maintaining a safe work place environment.

Andersen 2000 insists that its customers follow lockout/tag out safety procedures by using lockable valve(s) on make up water line(s), lockable valve(s) on compressed air line(s), lockable valve(s) on fuel line(s) and lockable disconnect(s) for all electrical supplies to Andersen equipment. Andersen disclaims any responsibility for any accidents resulting from customer failure to install and use this safety equipment.

A careful equipment operator is the key to safe job performance and the best insurance against preventing a system malfunction or serious accident. Operator safety and the safety of others depend upon reasonable care and judgment in the operation of the equipment. Most accidents are caused by failure to observe simple safety rules and precautions. Be aware of what is going on around the work area. Learn to recognize hazards before they become accidents and to avoid setting up dangerous situations.

General Safety Precautions

The purpose of these safety precautions is to make all personnel aware of the general hazards and dangerous situations that exist around the equipment and the work area.

1. Read and understand each of the cautions, warnings, and instructions in the operator's manual and on signs fixed to the equipment.

2. Inspect all equipment components before each operating shift to ensure that no parts are damaged or suspected of being damaged. Repair or replace damaged parts before starting or operating the equipment.

3. Check for warning tags and locks on equipment components or controls before starting or operating the equipment.

4. Do not allow unskilled persons to start or operate any equipment without the proper supervision of a skilled operator.

5. Never leave equipment controls unattended. Always have a qualified operator relieve you if you must leave.

6. When starting equipment, follow the manufacturers recommended starting sequence.

7. During startup and while the equipment is operating, be alert for improper readings, visual defects, odors or unusual sounds that could be a warning of a potential hazard. Shut down equipment immediately, following established shutdown procedures, if any unsafe condition

8. Do not work on equipment while it is in operation. Shut down, lockout, and tag all machine controls before performing any inspection, maintenance, lubrication or adjustment. Perform all required inspection, maintenance, lubrication or adjustments before starting or operating the equipment, or after the equipment is shut down.

9. Perform all inspection, maintenance, lubrication, and adjustment procedures with caution and in accordance with the manufacturer's recommended procedure.

10. Ensure that all guards and safety devices are properly installed and in working order before starting or operating the equipment.

11. Do not allow unauthorized personnel in or around the work area and equipment. Know who is in your work area at all times. Use a head count when necessary.

12. Refractory that has not been cured can release moisture explosively in the form of steam and debris from broken refractory if exposed to excess temperature or to rapid heat-up. If the system has any uncured refractory, it is necessary to cure it in exact accordance with instructions in this manual before starting up this system. Failure to do so will result in serious equipment damage and possible injury to operating personnel. Andersen disclaims any responsibility for damage or injury resulting from failure to cure or from improper curing of any refractory in the system.

13. Fuel can leak past damaged valves or burners in any incinerator system. Fumes from such leaking fuel can accumulate inside the rotary kiln melter and ignite explosively during system start-up. The burner safety systems are designed to prevent any such occurrence, but if any safeties have been bypassed, damaged or defeated, an extremely unsafe and explosive condition could develop rapidly. Do not operate any portion of this system if any safeties have been damaged, defeated or altered in any way and do not operate this system if you have not been properly trained. Do NOT depend on computerized controls to protect you from malfunctions.

Specific Safety Precautions

Because of the nature of the equipment, safety precautions cannot be overemphasized. It is essential to read and understand the following safety precautions before attempting to operate the equipment.

FAILURE TO HEED TO THESE PRECAUTIONS MAY RESULT IN SERIOUS PERSONAL INJURY OR DEATH

- Complete understanding of this manual is required before attempting to operate or maintain this equipment.
- Use safe working habits at all times.
- Never open any access door on the system while the incinerator is in operation.
- Stay clear of conveyors as they may start automatically. If necessary to repair or adjust any of the equipment, place the power switch in the off position and lock and tag the power disconnect switch.
- Do not rely on the hydraulic system to hold charge doors in the open position during inspection or maintenance. Securely block the doors open so they cannot close.
- Keep clear of all moving equipment and pinch points. Do not wear loose fitting clothing that can become caught in moving parts.
- Never enter the chambers of mechanical loaders, waste feed systems, ash conveyors, the incinerator or other equipment without first taking the normally recognized safety precautions of de-energizing and locking out all power sources. Also, all fuel supplies should be locked out as well.
- Do not enter any vessel unless all access doors are open and a positive ventilation system has been installed. Check for appropriate oxygen levels within the equipment and do not enter any vessel without checking for combustible or toxic gases. Work of this type should never be done alone, but always in the presence of a second individual who is familiar with the equipment control circuits involved and who is

also able to implement safety procedures, including rescue from the vessel, if required.

- Make sure all safety systems are operable (flame detectors, water sprays, emergency lockout devices and emergency stop switches) which have been provided as a part of the equipment system.

D. Hardware Inspection And Conditions For Operation

A thorough inspection of the equipment should be conducted before the equipment is started. This should include, but not necessarily be limited to, the following:

1. Primary Combustion Chamber (Ecomelt Generator R-201) and Secondary Combustion Chamber (Afterburner R-202).

The primary combustion chamber, R-201, is a refractory-lined rotary kiln. The secondary combustion chamber, R-202, is a refractory-lined horizontal afterburner with a natural-gas-fired burner.

There are numerous safety and burner interlocks on the kiln and afterburner units. Never bypass any of these interlocks. Caution should always be exercised in inspecting the hardware of the system. All access doors should be closed and secured. All the refractory lined breaching should be inspected for spalling, cracking and any other refractory damage.

The main shutoff fuel valves (isolation valves) on both the main burners and the pilot burners should be in the open position. **NOTE:** these are not the automatic burner valves. These are the isolation valves installed to allow maintenance and service of the burners.

The primary and secondary combustion chambers are both more fully described in the Equipment Specification section of this manual.

2. Air Pollution Control Equipment

The air pollution control system includes non-metallic components, baghouse filter media, which is not temperature resistant. The temperature limitation for the filter elements is 550°F or 288°C. Obviously, the outlet gas from the secondary combustion chamber (R-202) is considerably higher in temperature than the temperature limitation of the baghouse components. Therefore, it is essential that the quench water pump (P-301) and quench (Z-301) be activated and that liquid is flowing at an adequate rate before hot gas is admitted. It is essential that the operator checks all valve settings and pump operating conditions to insure that there is adequate liquid flow.

The system is equipped with temperature monitoring devices that activate solenoid valves that bleed in air to cool the gases in the event temperature exceeds 400°F. These temperature switches must not be disabled.

E. Utilities Availability

The rotary kiln melter system requires electrical power, instrument quality air, and natural gas and water supply systems to enable continuous operation. Interruption of any of these services may be detrimental to the system. The system has been designed to be fail-safe. Disabling or bypassing any of these systems is strictly forbidden. For example, if electrical power failure occurs, all of the controls are set to fail to a safe position.

F. Controls And Alarms

The rotary kiln melter system is a rather complex system equipped with a number of alarms to caution the operator about component parts of the system that need attention. It is important that these alarms are not bypassed. It is also important that all alarms be tested and verified at least weekly to insure that they are properly operational.

This system is also equipped with a very sophisticated controls system to control appropriate variables and to activate alarm and safety functions when necessary. The software and logic used in these controls must not be changed without consulting Andersen 2000.

G. Burner Safeties

Each burner has an appropriate burner safety system connected to it. Each burner will always have a low fuel pressure switch, a fan proving switch to prove operation of the combustion air fan, and a flame detector. The pressure switches must be calibrated at least annually. Under no conditions should the burners be operated if the flame detector is not functioning. Under no conditions should any of the burners be manually ignited. It is of critical importance that before any burner is started, a purge cycle takes place. This purge cycle involves blowing combustion air through the burner without fuel to "sweep" out any possible unburned fuel accumulations before any ignition is started. The burner safety controls accomplish this through a pre-programmed purge mode before the pilot flame is lit and before the main burner is turned on. **You** should refer to the vendor literature on the burners and burner safety control systems included in the Vendor Manual before attempting to operate any of the burners in the system. If any of the burner safeties furnished with this system are disabled, you automatically void any warranties on any of the component parts in the system and you also jeopardize the safety of the operators of the system.

H. Solids Conveying Systems

The rotary kiln melter system utilizes a number of product removal systems and conveyors to move solids. These systems must be well maintained at all times including lubrication of gears, drives and idlers and proper alignment and tensions. DO NOT attempt to adjust, service or repair conveyor systems while the unit(s) is in operation. Refer to the appropriate sections of the Vendor Manual for specifics with regard to conveyor installation, maintenance or repairs.

III. PROCESS SPECIFICATIONS

SEDIMENT PROCESSING

The system described in this document has been designed and constructed to treat contaminated materials dredged from harbors and rivers. Key design considerations include the ability for complete control of operational parameters in each component to efficiently tune the system for the most effective operation for specific contaminant removal and treatment.

The *Primary Treatment Unit* (or Ecomelt Generator) system consists of three component sub-systems. These components are; the material feed system, PTU (rotary drum), and the Ecomelt quench system. The material feed system equipment serves primarily to feed the sediment and modifiers into the thermal system for processing. The PTU heats the materials to the required processing / melting temperature and maintains the materials at the elevated temperature for a particular time period. The treated material quench system serves to cool the materials by direct water addition and mixing.

The gases produced in the PTU are treated by the *Secondary Treatment* system. Gases exiting the STU are cooled in a Quench Chamber prior to the baghouse. A baghouse is included for removal of particulates from the gas stream before the gases are exhausted to the Activated Carbon bed and subsequently to the atmosphere. Particulates captured in the baghouse are conveyed by a rotary feeder to a discharge bin (provided by others). An induced draft (I.D.) fan is located downstream of the carbon bed and serves as the mechanism to maintain flow throughout the system.

The system is versatile to allow the processing parameters to be established for individual remediation projects. The primary treatment unit should be operated at temperatures that prove sufficient for achieving the particular material treatment standards that are required. The gas treatment unit should be operated within a temperature range sufficient for the required destruction efficiency for the particular contaminants involved. Oxygen levels of the gas streams in the various components must be maintained to assure proper fuel combustion in the burners as well as oxidation of the contaminants. When the system is operated properly, the stack gas discharge contains a uniform oxygen content with minimal total combustibles and/or carbon monoxide. Burner and control adjustments are to be performed as necessary to maintain the required operational parameters.

The treated material leaves the Ecomelt Generator and is fed into the Ecomelt Quencher and the Granulator for cooling. The wet product is fed into the Ecomelt Dryer via the Wet Granulated Ecomelt Conveyor. The dry product is fed to the Ecomelt hopper via the Dried Ecomelt Conveyor and the Ecomelt Bucket Elevator. The gases from the Ecomelt Dryer are ducted to the Dryer Cyclone Separator and Bag Filter for removal of any particulates. The clean gases are vented to the atmosphere via the induced draft fan system.

The Ecomelt System will produce cleaned, processed materials as the primary product. This material will exit the system and is stored for subsequent distribution in the Ecomelt Hopper.

The drawing entitled Flow Diagram (Drawing 1148-3000) depicts the process as described including additional details of process interconnections with material and gas flow paths. Drawings 1148-3001, 1148-3002 and 1148-3003 are the rotary kiln melter system heat and mass balance sheets.

PRIMARY (MATERIALS) TREATMENT

The primary material treatment system consists of three component sub-systems which are; material feed system, PTU (rotary drum), and the treated material quench system. The process requirements for each of these components are identified below:

Feed System

The material feed unit is designed to receive the dredged sediment into the thermal treatment process while monitoring and controlling feed rates while adding modifiers. This is accomplished by a series of feed bins, feed conveyors, modifier hoppers, weigh screw feeders and mixing conveyor.

Primary Treatment Unit (PTU)

The PTU is a rotary drum in which contaminated materials are heated to a specific temperature at which the contaminants become vaporized and transfer to the PTU gas stream. Heat is provided by the burner system which utilizes natural gas to produce a flame. The burner system is designed with the ability of adding air to control the temperature of the combustion products from the fuel burning process. The flame supplies energy to the materials by radiation and conductive heat transfer. The chamber is fed on a continuous basis from the feed system. Once the sediment and modifier mixture is introduced into the drum, the drum functions to convey materials away from the inlet and into the burner zone. Once the mixture reaches the targeted processing temperature, it melts completely. The rotational speed of the chamber can be varied to alter retention time of the materials based on contaminant type and specific processing conditions. The material processing rate is directly related to the drum volume and varies with moisture content and treatment temperatures as well as contaminant type and concentration.

Ecomelt Quench System and Granulator

The molten material will be conveyed by the combination of kiln slope and rotation to the rear of the rotary kiln where via gravity it will be discharged into a refractory-lined chamber where it will be contacted by water sprays prior to falling into the wet Ecomelt conveyor. In order to assure that the molten material is free flowing until contacted by the water sprays, a 1.5 MM Btu/hr packaged burner system is incorporated into this discharge section of the rotary kiln melter system.

After being contacted with water sprays in the discharge section of the rotary kiln, the Ecomelt material will fall into a wet-type, drag conveyor for delivery to the Ecomelt transfer screw conveyor and subsequently the Ecomelt Dryer. The wet-type drag conveyor is provided with a 2 HP motor and gear drive as well as a 150 gpm, 40 psi, 7.5 HP, 3600 rpm cast iron pump to provide cooling water to the Ecomelt discharge section of the rotary kiln.

SECONDARY (GAS) TREATMENT

The gases leaving the PTU are treated by a Secondary Combustion Chamber, emergency bypass stack, flue gas quench, lime feed system, baghouse and activated carbon bed.

Secondary Treatment Unit (STU)

The STU is a thermal oxidizer designed as a horizontal cylindrical vessel lined with insulating refractory suitable for operational temperatures. A direct-fired burner supplies supplemental energy to maintain the desired outlet temperature of the gases. The function of the STU is to provide intimate flame contact with the gases, elevate the gas temperature to the targeted operational temperature, and provide retention of these gases within the chamber. This is based on estimated operational parameters of 2550°F at 2 seconds retention time for the gases. The gas volume entering the chamber along with the anticipated operational temperature and excess oxygen level is the basis for the size of the unit. The STU burner blower provides combustion air as well as the remaining air needed for oxidation of the contaminants. The system must be operated under this basis.

Evaporative Gas Cooling Chamber/Flue Gas Quench System

The gases from the STU must be cooled to a temperature that is suitable for the baghouse. This is accomplished by a vertical gas cooling chamber that reduces the temperature of the STU exhaust gases. The system operates by spraying a controlled volume of atomized water into the gas stream. The volume of atomized water is modulated according to the baghouse inlet gas temperature. As this temperature changes, the volume of cooling water is regulated to maintain the baghouse gas inlet temperature at 350°F or below to avoid damage to the baghouse filters.

Lime Injection/Baghouse System

A pulse-jet fabric filter collector has been provided for particulate filtration. The system includes lime injection (for acid gas removal) upstream of the particulate filtration system. The baghouse contains bags comprised of filter material through which the process gases pass. Dust is collected on the outside surface of the filter bags. This dust is periodically removed by a compressed air pulse-jet system which is operated to maintain the recommended operating pressure drop across the baghouse tube-sheet. The targeted operational temperature is 350°F. As dust is continuously removed from the exhaust gas stream inside the baghouse, it is collected in the baghouse hopper. The fines are then transferred by a rotary feeder to a discharge point for collection by others.

Activated Carbon Adsorption Bed

The activated carbon bed is an oblong vessel constructed of ¼" thick carbon steel. The vessel has been constructed with two, 2' thick layers (beds) of activated carbon. Each bed receives one half of the process gas flow. The activated carbon is "NORIT RBHG 4". NORIT RBHG 4 is a sulfur-impregnated steam activated extruded carbon. It is especially developed for the removal of mercury vapors from natural gas, air, hydrogen and other gases. It is impregnated in a special way with a sulphur component that forms with mercury vapor stable, non-volatile mercuric sulfide. It is based on a highly porous extruded carbon.

Each bed has been supplied with four temperature switches used to detect a fire in the bed. In the event of a high temperature excursion, a water deluge system is activated.

Draft System

The system includes the induced draft (I.D.) fan with flow damper to modulate and control the gas flow. The I.D. fan pulls the process gases through the entire system and pushes the treated gases out the stack. The gas flowrate is controlled by monitoring the internal pressure of the PTU near the PTU burner. As this pressure changes, the draft fan damper is adjusted to maintain uniform draft at the PTU feed end.

PROCESSED MATERIALS

The system will produce remediated, processed materials as the primary product. This material will exit the system and will be conveyed to a clean material storage hopper.

SAFETY EQUIPMENT

Safety systems are an integral part of the plant controlling and monitoring equipment. Both the PTU and STU burners include automatic control systems with high temperature shut-down capabilities. When activated, these limit systems will result in automatic shut-down of the burner system. The system will activate if the exit gas temperature of either the primary chamber, secondary chamber or other components exceeds preset limits. Burners are designed with the capability to modulate down to a very low firing rate to compensate for the contaminated materials. Burners include ultra-violet (UV) flame scanners as part of the burner safety systems which will shut down the burners and prevent fuel introduction if verification of flame is not confirmed. Fuel pressure safety switches and a timed purge cycle are also built into the burner control equipment.

The feed conveyor system is equipped with local stop cables mounted along the conveyor frame. This cable will stop the movement of the conveyor when tripped. The cables must be tripped manually when needed. These stop devices are intended to be used anytime a situation exists where personnel must access areas near the moving conveyors and prior to performing any type of maintenance in these areas.

Caged ladders, platforms with toe-plates and handrails are provided at certain locations throughout the system. These items are provided to promote personnel safety when accessing the equipment.

Other equipment for personnel safety should be used and incorporated into the system personnel safety program (i.e., fall harnesses, protective clothing, etc.) as required per local codes/regulations by the customer.

IV. COMPONENT SPECIFICATIONS

Sediment Storage Bin (T-101)

The sediment storage bin is a Cor-Ten steel bin with a storage capacity of 2,450 cubic feet of dredged sediment. Reference Jervis B. Webb Co. drawings #E-01 and E-02.

Alternate Feed Bin (T-102)

The Alternate Feed Bin is a stainless steel bin with a storage capacity of 660 cubic feet of dredged sediment. The bin is constructed of 304L stainless steel and includes all necessary structural supports for installation at the plant facility. The bin includes a sludge bin trough with a dual screw feeder. Reference Andersen 2000 drawings 1148-2050 through 1148-2061.

Transfer Conveyor (C-102)

This transfer conveyor is a 15° inclined, totally enclosed, 12" screw conveyor. This conveyor is sized to deliver 104.3 cubic feet per hour of alternative feed material weighing 76.8 #/cu. ft. to the transfer conveyor (C-101). Reference Jervis B. Webb Co. drawing #E-04.

Transfer Conveyor (C-101)

This transfer conveyor is a 15° inclined, totally enclosed, 12" screw conveyor. This conveyor is sized to deliver 108 cubic feet per hour of river sludge or alternate feed material weighing 76.8 #/cu. ft. to the weigh screw conveyor (C-112). Reference Jervis B. Webb Co. drawing #E-03.

Weigh Screw Conveyor (C-112)

This weigh conveyor is a horizontal, totally enclosed, 12" screw conveyor. This conveyor is sized to deliver 108 cubic feet per hour of material weighing 76.8 #/cu. ft. to the sediment/modifier mixer (M-131). This conveyor has been supplied with load cells to determine the process feed rate. Reference Jervis B. Webb Co. drawing #E-05.

Modifier #1 Hopper (T-103) with Live Bin Bottom, Slide Gate and Vibratory Feeder (V-103, HV-103, and F-103)

The storage hopper is sized to accommodate a capacity of 2,500 cu. ft. of modifier #1. The storage bin is 10' O.D. and 36' in height including the cone discharge section at the base of the hopper. The storage hopper is constructed of ¼" carbon steel and is provided complete with all necessary support structure. The storage bin discharge consists of a cone bottom equipped with a 5' O.D. live bin activator (V-103). The outlet

of the bin activator is equipped with a 10" maintenance gate (HV-103). The live bin activator feeds material into a vibratory feeder (F-103). Reference Andersen 2000 drawings 1148-2110 through 1148-2117 and Metalfab drawings J-499048 and J-499049.

Bin Vent Filter (S-103)

Also included is a Griffin Environmental Co. Model JV-24-6X bin vent filter constructed of mild steel with 186 square feet of filter area. Reference Griffin drawing GA3-29693-V-01.

Screw Conveyor For Modifier #1 Material (C-103)

This conveyor is a horizontal, totally enclosed, 6" screw conveyor. This conveyor is sized to deliver 14 cubic feet per hour of modifier #1 weighing 90 #/cu. ft. to the sediment / modifier mixer (M-131). Reference Jervis B. Webb Co. drawing #E-06.

Modifier #2 Hopper (T-104) with Live Bin Bottom, Slide Gate and Belt Feeder (V-104, HV-104 and F-104)

The storage hopper is sized to accommodate a capacity of 130 cubic feet of modifier #2. The storage bin is 5' O.D. and 8'-10" in height including the cone discharge section at the base of the hopper. The storage hopper is constructed of 3/16" carbon steel and is provided complete with all necessary support structure. The storage bin discharge consists of a cone bottom equipped with a 3' O.D. live bin activator (V-104). The outlet of the bin activator is equipped with an 8" maintenance gate (HV-104). The live bin activator feeds material into a belt feeder (F-104). Reference Andersen 2000 drawings 1148-2120 through 1148-2123 and Metalfab drawings J-499050 and J-499051.

Bucket Elevator For Loading Modifier #2 (C -104)

The bucket elevator is sized to accommodate top loading of the modifier #2 hopper (T-104) from grade level and has a capacity of 94 cubic feet per hour of material. The bucket elevator is constructed out of carbon steel and is provided complete with a 1 HP motor, gear reducer, dump hopper, bag breaker, screen and cover. Reference Andersen 2000 drawing 1148-2125.

Sediment / Modifier Mixer (M-131)

The paddle mixer is a FEECO Model 2208 fabricated from carbon steel. The unit includes twin shaft design, paddles, a 23" wide x 8' long trough and drive package with motor and reducer. The paddle mixer is designed to accept material from the sediment storage bin, alternate feed bin, modifier #1 hopper and modifier #2 storage hopper. Reference FEECO drawing 1113376.B32D.

Water Cooled Auger / Screw Feeder (C-151)

This water-cooled auger is a 12" screw conveyor sized to deliver 117 cubic feet per hour of material weighing 78 #/cu. ft. into the Ecomelt Generator (R-201). This auger has a water cooled jacket as well as a water-cooled screw shaft. This feeder has been supplied with a bottom discharge for "off-spec" material if the screw rotation is reversed. Reference Jervis B. Webb Co. drawing #E-2.

Ecomelt Generator (R-201)

The rotary kiln system is a FEECO / Andersen 2000 rotary kiln which has an 8'-7¾" diameter inside the 9½" thick refractory lining and is 30' from seal to seal. The kiln is 10'-4½" outside diameter with a shell constructed of ¾" thick hot rolled steel. The steel shell is first lined with a 1/8" thick Witco stalastic fiber loaded asphaltic material that provides a 500°F membrane lining over the steel. Then there are two layers of ¼" thick millboard, a 3" thick layer of insulating fire brick followed by a 6" layer of high density, 80% alumina fire brick for the hot face section. The kiln is designed with a slope of ¼" in 12" from the horizontal and includes two hardened steel tire supports on hardened steel trunnions. The kiln is designed to operate between 0.2 and 1.0 RPM. Maximum heat release in the kiln is 30 MM Btu/hr or 17,033 Btu per cubic foot per hour. A gear reducer is used which is powered by a 40 HP, TEFC motor. A variable frequency controller is used to provide variable drum speed. The kiln system is designed to process 3,431 #/hr (9195 #/hr with oxygen enrichment) of the combined sediment and modifier component mixture as indicated in the material balance information on drawing 1148-3001. The sediment and modifier component mixture is fed to the kiln system via the water-cooled auger/screw feeder (C-151). Reference Andersen 2000 drawings 1148-2200 through 1148-2214 and Jervis B. Webb Company drawing #E-2.

Secondary Combustion Chamber/Afterburner (R-202)

The afterburner is a horizontal cylindrical chamber that is 7'-2¼" inside refractory diameter. The secondary chamber is constructed of ½" carbon steel that is coated with a 1/8" thick Witco stalastic fiber loaded asphaltic membrane material. The refractory in the secondary chamber will utilize a three part lining which includes a ¼" thick Inswool paper, a 3" thick insulating refractory followed by an additional 6" of hot face gunable refractory material. The usable volumetric capacity of the secondary combustor is capable of providing in excess of 2 seconds residence time at the maximum design gas flow rate and temperature as indicated in the material balance information on drawing 1148-3001. Reference Andersen 2000 drawings 1148-2400 through 1148-2402.

Gas Fired Burners (HX-201 & HX-202)

A 30 MM Btu/hr natural-gas-fired burner as manufactured by North American Manufacturing Co. is installed in the rotary kiln and one additional burner rated at 6 MM Btu/hr is installed in the secondary combustor (afterburner). The secondary

combustor burner will also be a North American Manufacturing Co. combustion system. The burners are installed through refractory burner tile in accordance with recommendations by the manufacturer. All necessary flame safety systems, fuel train components and combustion air fans are incorporated with both burner systems.

Ecomelt Discharge System (HX-203 and Z-203)

The molten material is conveyed by the combination of kiln slope and rotation to the rear of the rotary kiln where via gravity it is discharged into a refractory-lined chamber. The molten material is contacted by water sprays prior to falling into the wet Ecomelt conveyor. In order to assure that the molten material is free flowing until contacted by the water sprays, three (3) 500,000 Btu/hr burners are incorporated into this discharge section of the rotary kiln system. These burners are provided complete with all necessary flame safeguards, fuel train, and combustion air components. Reference Andersen 2000 drawings 1148-2300 through 1148-2326.

Granulator with Recirculation Tank and Water Pump (C-203, T-203 and P-203)

After being contacted with water sprays in the discharge section of the rotary kiln, the Ecomelt material will fall into a wet-type, drag conveyor for delivery to the Ecomelt transfer screw conveyor and subsequently to the Ecomelt Dryer. The wet-type drag conveyor is provided with a 2 HP motor and gear drive. Liquid level is maintained in this granulator by a float-controlled level control valve mounted in the recirculation tank. The liquid simply overflows from the granulator into this tank. A 150-GPM, 40 psi, 7.5 HP, 1750 RPM cast iron pump provides cooling water to the Ecomelt discharge section of the rotary kiln. Reference Andersen 2000 drawings 1148-2070 through 1148-2075 and Jervis B. Webb Co. drawing #E-1.

Wet Granulated Ecomelt Conveyor and Rotary Feeder (C-205 and F-205)

This transfer conveyor is a 25° inclined, totally enclosed, 12" screw conveyor, and is sized to deliver 300 cubic feet per hour of granulated Ecomelt material weighing 56 #/cu. ft. The screw conveyor is constructed of carbon steel and discharges into a 12"x12" Meyer cast iron rotary airlock feeder which is connected to the Ecomelt Dryer (D-206). Reference Jervis B. Webb Co. drawing #E-07.

Quencher and Double Tipping Valve (Z-301 and KV-301 / KV-302)

The hot flue gas from the discharge of the secondary combustor (afterburner) discharges into an evaporative cooler type quench system where the hot flue gas is contacted with water in order to reduce the flue gas temperature to a level acceptable to the fabric filter baghouse. Drawing 1148-3001 provides information relative to the inlet and outlet gas conditions for the evaporative cooler/quench chamber and information for the evaporative cooler/quench system. The upper portion of the quench chamber is constructed out of carbon steel lined with 1/8" thick Witco stalastic fiber loaded

asphaltic membrane material. The refractory in this area consists 1" thick insulating board followed by an additional 6" of hot face gunable refractory. The remainder of the evaporative cooler/quench system is constructed of ¼", 316L S.S. The base portion of the evaporative cooler consists of a cone section with a 60° sloped wall that feeds into a Plattco Corp. 12"x12" cast iron double tipping valve. All necessary support structure, quench nozzles, and cooling water manifold piping have been provided. Reference Andersen 2000 drawings 1148-2700 through 1148-2713 and Plattco Corp. drawing 17713-0.

Quencher Water Pump (P-301)

Cooling water to the evaporative cooler / quench system, to the water-cooled auger / screw feeder and to the Ecomelt granulator recirculation tank is provided by an 80 gpm, 100 psig, 15 HP, 1750 RPM cast iron pump.

Quencher Water Tank (T-301)

The tank is an XLHDPE rotationally molded, 11,000-gallon capacity tank for storage of water for the evaporative cooler / flue gas quench water system. Reference Andersen 2000 drawing 1148-2761.

Stack Cap and Accumulator (S-202 and T-202)

The stack cap is a refractory lined head constructed of ¼" thick carbon steel. It is counterweighted so that it will open in the event positive pressure in the system exceeds about 1" W.G. There is also a separate actuator for the stack cap using a pneumatic cylinder, pulling against a 316L S.S. chain, to open in the event power fails, the quencher fails or the rotary kiln melter shuts down. A 3-gallon capacity stationary air tank has been provided to provide sufficient air to open the stack cap in the event of power failure. The counterweight mechanism has been provided with a trim tank that can be filled with water and automotive anti-freeze mixture to provide for fine adjustment of the counterweight. Reference Andersen 2000 drawings 1148-2450 through 1148-2455.

Lime Hopper (T-302) with Live Bin Bottom, Slide Gate, Vibratory Feeder, and Rotary Airlock (V-302, HV-302, F-302 and F-302A)

The lime storage hopper is constructed of ¼" carbon steel and has a storage capacity of 500 cubic feet. The storage hopper is 75" O.D. with a vessel height of 20' including the cone bottom section of the hopper. The cone section will include a minimum 60° slope for feed of lime into a 3' O.D. live bottom bin actuator (V-302). The outlet of the bin activator is equipped with a 10" maintenance gate (HV-302). The live bin activator feeds material into a vibratory feeder (F-302) which in turn discharges into a 6"x6" Meyer cast iron rotary airlock feeder (F-302A). Reference Andersen 2000 drawings 1148-2810 through 1148-2816 and Metalfab drawings J-499053 and J-499054.

Vent Filter (S-302)

Also included is a Griffin Environmental Co. Model JV-24-6X bin vent filter constructed out of mild steel with 186 square feet of filter area. Reference Griffin drawing GA3-29693-V-01.

Lime Eductor Blower (B-302)

The lime eductor blower takes a slipstream from the discharge of the flue gas quencher and employs it to inject lime into the duct upstream from the baghouse. This is an Arrangement 9 centrifugal fan rated for 415 ACFM at 8" W.G. on 350°F flue gas and is powered by a 2 HP motor. Reference Fan Equipment drawing 99037401.

Baghouse and Rotary Airlock (S-303 and F-303)

The operating conditions for the baghouse are shown in drawing 1148-3003. Design differential pressure across the baghouse is 6" W.G. The baghouse includes all necessary access ladders and cages and one Meyer 8"x8" rotary airlock of cast iron construction (F-303). The baghouse is supplied complete with 324, 6" O.D. by 10' long P84 bags. The baghouse has a cloth area of 4,973 square feet, which provides for a 4.18:1 air-to-cloth ratio at the gas flow and temperature indicated on the material balance information in drawing 1148-3003.

Activated Carbon Bed (A-304)

This vessel is constructed of ¼" thick carbon steel and is configured for two 2' layers of activated carbon. This vessel has been provided with fire detection thermocouples and a fire protection spray manifold for each carbon bed. Reference Andersen 2000 drawings 1148-2850 through 1148-2857.

Air Compressor (P-305)

Compressed air for the system is provided by a Gardner Denver or equal Model ECPQM 100 HP, rotary screw type compressor with reduced voltage starter. The air compressor is capable of delivering up to 320 scfm of compressed air at 125 psig. The air compressor system is provided complete with a dryer in order to provide instrument quality air for the plant.

Surge Tank (T-305)

The air compressor has been provided with a 350-gallon air receiver tank.

Induced Draft Fan (B-304)

The induced draft fan is an Andersen 2000 Model M-IV-33-HE induced draft fan. The fan is designed for an inlet gas flow of 24,220 acfm and a total differential pressure of 14.35" W.G. The fan performance data is shown in drawing 1148-2900. The fan is equipped with a 100 HP, 1775 RPM TEFC drive motor. The fan is driven in Arrangement 9 at 1250 rpm. Materials of construction for the fan are carbon steel. Reference Andersen 2000 drawings 1148-2900 and 1148-2901.

Exhaust Stack (S-304)

The exhaust stack for the system is 36" I.D. and 50' tall. Materials of construction for the stack is ¼" carbon steel. The stack has been provided with two sets of EPA sampling ports for isokinetic sampling, two opacity meter ports, a flow meter connection, a thermocouple connection and a C.E.M. sample probe connection. Reference Andersen 2000 drawings 1148-2820 through 1148-2823.

Ecomelt Dryer with Burner (D-206 and HX-206)

A rotary dryer manufactured by FEECO International has been provided to dry the wet Ecomelt product discharged from the rotary kiln to a dry condition. This rotary dryer is 3' I.D. and 30' long. The unit is constructed of ¼" thick carbon steel and includes specially designed lifters for maximum air-to-material contact. The dryer is supplied complete with tires, girth and pinion sprocket, chain, trunnion wheels, trunnion bases, 5 HP motor, gear reducer and couplings mounted on a unitized drive base. A refractory-lined combustion chamber complete with a 1 MM Btu/hr burner and all necessary flame safeguards, combustion air blower, and fuel train components has also been provided. Reference FEECO International drawing 1113361.B43D.

Rotary Feeder from Ecomelt Dryer (F-206)

The discharge of the Ecomelt Dryer is provided with a Meyer 12"x12" rotary airlock feeder package of cast iron construction for transfer of the dried Ecomelt material into a screw conveyor for delivery to a bucket elevator.

Dried Ecomelt Conveyor (C-216)

This transfer conveyor is a 4.63° inclined, totally enclosed, 12" screw conveyor. This conveyor is sized to deliver 120 cubic feet per hour of 250°F Ecomelt material weighing 40 #/cu. ft. This screw conveyor accepts the discharge from the cyclone separator and bag filter downstream from the Ecomelt dryer as well as the dried Ecomelt material being discharged from the dryer system. This Ecomelt transfer conveyor connects directly to the bucket elevator. Reference Jervis B. Webb Co. drawing #E-08.

Dried Ecomelt Bucket Elevator (C-217)

The bucket elevator is sized to accommodate top loading of the Ecomelt storage silo from grade level and has a capacity of 800 cubic feet per hour. The bucket elevator is constructed of carbon steel and is provided complete with a 3 HP motor, reducer, and high-temperature feed belt. Reference Andersen 2000 drawing 1148-2605.

Ecomelt Hopper (T-219) with Live Bin Bottom, Slide Gate and Rotary Airlock (V-219, HV-219 and F-219)

This storage silo has a capacity of 6,750 cubic feet and is constructed of ¼" carbon steel. The storage silo is 14' O.D. and 57' in height including the cone discharge section of the vessel. Discharge from the silo is via a cone section with a slope of 60° that feeds into a 7' O.D. live bottom bin activator (V-219). The outlet of the bin activator is equipped with a 10" maintenance gate (HV-219). The live bin activator feeds material into a Meyer 12"x12" rotary airlock which discharges to the Ecomelt product conveyor. Reference Andersen 2000 drawings 1148-2600 through 1148-2604 and Metalfab drawing J-499052.

Ecomelt Product Conveyor (C-219)

After discharge from the Ecomelt storage hopper, a screw conveyor is provided to transfer the dried Ecomelt product to a portable container provided by others. This product conveyor is a 19.8° inclined, totally enclosed, 12" screw conveyor. This conveyor is sized to deliver 300 cubic feet per hour of Ecomelt weighing 40 #/cu. ft. Reference Jervis B. Webb Co. drawing #E-09.

Dryer Cyclone Separator and Dust Discharge Rotary Feeder (M-401 and F-401)

The cyclone is designed for 550 acfm of 250°F flue gas exiting the Ecomelt Dryer. The cyclone is constructed of 14-gage carbon steel and the overall vessel height is 47". The cyclone has been provided with a Meyer 6"x6" rotary airlock of cast iron construction for discharge to the dried Ecomelt screw conveyor.

Bag Filter for Cyclone Discharge Dust Discharge Rotary Feeder (S-402 and F-402)

This bag filter is a Griffin Environmental Co. Model JV-24-6X bin vent filter constructed of mild steel with 186 square feet of filter area. The dust hopper for this bag filter has been provided with a Meyer 6"x6" rotary airlock of cast iron construction for discharge to the dried Ecomelt screw conveyor. Reference Griffin drawing GA3-29693-V-01.

Ecomelt Dryer Induced Draft Fan (B-402)

This is an Arrangement 9 centrifugal fan rated for 385 acfm at 250°F with a total differential pressure of 10" W.G. The fan is of carbon steel construction and has been supplied with a 2 HP, 1800 RPM drive motor. Reference Fan Equipment drawing 99037402.

Vent Stack (S-403)

The vent stack is 6" pipe with a rain hood. It is mounted on the discharge flange of the Ecomelt dryer I.D. fan (B-402). Reference Andersen 2000 drawing 1148-2655.

Continuous Emissions Monitoring System.

The continuous emissions monitoring system is a Rosemount system for monitoring carbon monoxide (CO), opacity and oxygen (O_2) in the flue gas discharging from the rotary kiln system. The system is provided in an air conditioned enclosure for installation outdoors near the exhaust stack.

VI. PLANT START-UP PROCEDURES

A. General

It is strongly suggested that an Andersen engineer be present during all first time operations of the system. Before attempting to operate any equipment, a detailed, comprehensive visual inspection must be made to verify that the entire system is correctly assembled and all bolted connections and anchor bolts are tight. Liquid lines should be verified to be free of leaks. All electrical connections should be checked for continuity, all 480V power wiring and motors 100 HP and above should be meggered, all thermocouples and wiring calibrated, all instruments calibrated, all solenoid valves and actuators manually energized / de-energized, all control valves and actuators stroked, all pneumatic tubing pressure sensing lines connected, all belt driven equipment checked for alignment and belt tension, all motors on rotating equipment "bumped" for correct rotation, and the pH probe in the granulator recirculation tank piping calibrated. Refer to the vendor manuals for first time start up instructions and calibration procedures.

B. Preparation For Initial Startup

Before attempting to startup the equipment, the following preparations must be made.

B.1. Water Tanks

The inspection manways and doors should be removed to inspect the insides of the quencher water tank (T-301) and the granulator recirculation tank (T-203) to insure that no construction debris remains inside the equipment after erection and installation activities are complete. To the maximum practical extent possible, these tanks should be washed down with fresh water to minimize the possibility of plugging pumps, nozzles, etc. with undetected construction debris.

B.2. Air Compressor (P-305) and Instrument Air Dryer

Start the compressor and allow unit to generate supply of compressed air. Start the plant air dryer by turning the switch to the "ON" position.

B.3. Ecomelt Generator (R-201), Secondary Combustion Chamber (R-202), and Granulator (C-203)

a. Before operating the Ecomelt generator, all inspection manways and doors should be removed to inspect the inside of the rotary kiln, secondary combustion chamber (R-202), drop out box, melt section and granulator (C-203). Any construction debris remaining inside the equipment should be swept out after erection and installation activities are complete.

b. Inspect the stack cap assembly. Verify that the stack cap will open upon loss of power to solenoid valve PY-202. The exhaust mufflers on this solenoid valve should be adjusted for smooth stack cap operation. Tighten the mufflers all the way down to a closed position then open them 1/8th of a turn at a time, to adjust the speed at which the stack cap opens and closes (approximately 10-15 seconds to open or close).

c. Inspect the rotary kiln trunnions and drive system for proper alignment and shimming. Start the rotation of the rotary kiln and continue observing the trunnions and drive system. Tighten the drive or shim the trunnions as necessary for a smooth operation. See Trunnion alignment standard operating procedures in Section XI.

d. Check the granulator (C-203) for proper alignment and adjustments of the flights and chains. Re-tension the chains if necessary.

e. Start the granulator (C-203) and observe the operation of the chains and flights. Shut down the system if any binding or jamming occurs. Make adjustments as necessary.

B.4. Quencher (Z-301), Baghouse (S-303), Activated Carbon Bed (A-304), and I.D. Fan (B-304)

a. All inspection manways and doors should be removed to inspect the inside of these vessels, fans, and ductwork to insure that no construction debris remains inside the equipment after erection and installation activities are complete. To the maximum practical extent possible, the inside of these systems should be cleaned of all construction debris.

b. Start quencher double tipping valves (K-301 and KV-302) and verify tipping action.

c. Start baghouse discharge rotary airlock feeder (F-303) and verify proper action. Once these systems have been checked out, they can be shut off.

d. Close the inlet damper to the I.D. fan (PV-201).

e. Start the I.D. fan (B-304) and check for proper rotation and function.

B.5. Continuous Emissions Monitor (CEM)

Continuous emissions monitors are provided to monitor the discharge flue gas for opacity, carbon monoxide and oxygen at the final scrubber exhaust. Please refer to the vendor manual for detailed startup and calibration procedures for these CEMS. These CEMS must be calibrated prior to system operation. The signals received from the CEMS for carbon monoxide (CO) and oxygen (O_2) are used in the control and alarm functions of the PLC. The opacity blower should be turned on with the local start-stop hand switch (HS-105).

B.6. Ecomelt Dryer (D-206) System

a. Before operating the Ecomelt dryer system, all inspection manways and doors should be removed to inspect the inside of the rotary kiln (dryer), wet granulated Ecomelt conveyor (C-205) and the dried Ecomelt conveyor (C-216). Any construction debris remaining inside the equipment should be swept out after erection and installation activities are complete.

b. Inspect the rotary kiln trunnions and drive system for proper alignment and shimming. Start the rotation of the rotary kiln and continue observing the trunnions and drive system. Tighten the drive or shim the trunnions as necessary for a smooth operation. See trunnion alignment standard operating procedures in the FEECO operating manual.

B.7. Ecomelt Product System

a. Start the wet Ecomelt rotary feeder (F-205) and verify proper action.

b. Start the wet granulated Ecomelt conveyor (C-205) and check for proper rotation and function.

   Once these systems have been checked out, they can be shut off.

c. Start the dried Ecomelt bucket elevator (C-217) and verify proper action.

d. Start the dried Ecomelt conveyor (C-216) and check for proper rotation and function.

e. Start the dryer discharge rotary feeder (F-206) and verify proper action.

f. Start the dryer cyclone dust discharge rotary feeder (F-401) and verify proper action.

g. Start the bag filter dust discharge rotary feeder (F-402) and verify proper action.

h. Start the Ecomelt dryer induced draft fan (B-402) and verify proper rotation and function.

   Once these systems have been checked out, they can be shut off.

i. Start the Ecomelt product conveyor (C-219) and check for proper rotation and function.

j. Start the Ecomelt hopper discharge rotary feeder (F-219) and verify proper action.

k. Start the live bin bottom (V-219) and verify proper action.

Once these systems have been checked out, they can be shut off.

B.8. Lime Eductor System

a. Start the lime feeder airlock (F-302A) and verify proper action.

b. Start the volumetric feeder (F-302) and check for proper rotation and function.

c. Start the live bin bottom (V-302) and verify proper action.

d. Start the lime eductor blower (B-302) and verify proper rotation and function.

Once these systems have been checked out, they can be shut off.

B.9. Combustion Air and Nose Cooling Blowers

a. Close the Ecomelt Generator combustion air blower's discharge damper (AV-103).

b. Start the Ecomelt Generator combustion air blower (B-201) and verify proper rotation and function.

c. Close the secondary combustion chamber air blower's discharge damper (TV-133).

d. Start the secondary combustion chamber air blower (B-202) and verify proper rotation and function.

e. Close the melt section combustion air blower's discharge damper (TV-163).

f. Start the melt section combustion air blower (B-203) and verify proper rotation and function.

g. Close (manually) the Ecomelt Generator nose cooling blower's discharge damper.

h. Start the Ecomelt Generator nose-cooling blower (B-207) and verify proper rotation and function.

i. Completely open the discharge damper to the Ecomelt Generator nose cooling blower. The low-pressure alarm "PAL-207" should clear.

Once these systems have been checked out, they can be shut off.

B.10. Tank Filling and Leak Checking

The access doors on the quencher water tank (T-301) and the granulator recirculation tank (T-203) should be closed.

a. Quencher Water Tank (T-301)

1. Fill the quencher water tank to its operating level.

2. Be sure all pump inlet and outlet block valves are open.

3. Turn on the quencher water pump (P-301) and check for proper rotation and function.

4. Check the entire quencher water piping throughout the plant for leaks and repair as required.

5. Fill the granulator recirculation tank to its operating level.

b. Granulator Recirculation Tank (T-203)

1. Once this tank has been filled to its proper operating level all pump inlet, seal flush and outlet block valves should be opened.

2. Start the granulator recirculation pump (P-203) and check for proper rotation and function.

3. Adjust the liquid flows to the weir and spray nozzles. Weir flow rate should be 120 GPM. The flow rate to the spray nozzles should be between 31 and 62 GPM.

4. Check the entire granulator system piping for leaks and repair as required.

B.11. Bin Vent Filters

a. Open the valve on the 4" fill line to modifier #1 hopper (T-103).

b. This should close the limit switch on the valve (ZSO-T103), which will energize the pulse timers (K-103).

c. Verify proper action and close the valve when finished.

d. Open the valve on the 4" fill line to the lime hopper (T-302).

e. This should close the limit switch on the valve (ZSO-302) which will energize the pulse timers (K-302).

f. Verify proper action and close the valve when finished.

B.12. Baghouse (S-303) and Bag Filter (S-402) Controls

a. Pull the fuses to the baghouse and bag filter pulse timers in the main control panel (TS-1-11U and TS-1-12U).

b. Open the baghouse and bag filter control panels (K-303 and K-402) and install alligator clipped jumper across the "pressure switch input" terminals.

c. Install the fuse for the baghouse (TS-1-11U). This should start the pulse cleaning operation.

d. Verify proper operation and remove the jumper when finished.

e. Install the fuse for the baghouse filter (TS-1-12U). This should start the pulse cleaning operation.

b. Verify proper operation and remove the jumper when finished.

B.13. Modifier 1 and 2 Feed Systems

a. Start the water-cooled auger/screw feeder (C-151). Verify correct rotation and function.

b. Start the sediment/modifier mixer (M-131). Verify correct rotation and function.

c. Start the vibe/belt feeder (F-104). Verify correct rotation and function.

d. Start the live bin bottom (V-104) and verify proper function.

Once the belt feeder and live bin bottom have been checked out, they can be shut off. Do not shut off the water-cooled auger/screw feeder or the sediment/modifier mixer.

e. Start the vibratory feeder (F-103). Verify correct rotation and function.

f. Start the live bin bottom (V-103) and verify proper function.

Once the vibratory feeder and live bin bottom have been checked out, they can be shut off. Do not shut off the water-cooled auger/screw feeder or the sediment/modifier mixer.

B.14. Raw Sediment Feed Systems

a. Start the weigh screw feeder (C-112). Verify correct rotation and function

b. Start the transfer conveyor (C-101). Verify correct rotation and function

c. Start the transfer conveyor (C-102). Verify correct rotation and function

d. Start the alternate feed bin (screws) (T-102). Verify correct rotation and function.

e. Start the raw sediment storage bin (screws) (T-101). Verify correct rotation and function.

Once these items have been checked out, they can be shut off. The water-cooled auger/screw feeder (C-151) and the sediment/modifier mixer (M-131) can also be shut off.

C. First Time Startup and Refractory Curing Procedures

C.1. Scrubbing System Preparation

The quencher water tank (T-301) and the granulator recirculation tank (T-203) should be full of water and at their normal operating levels. All pump inlet, outlet and pipe rack valves must be open. The block valves for the pumps seal flush connection on the Ecomelt quencher water pump (P-203) must also be open.

All of the process controllers (except for the burner temperature controls) should be in automatic mode. The system should be started up in the exact sequence presented below. After starting up a pump, the operators should check the particular system for any problems and/or abnormalities.

a. Turn on the quencher water pump (P-301).

b. Adjust the water flow to the water-cooled auger / screw feeder to 30 gpm.

c. Turn on the Ecomelt quencher water pump (P-203).

d. Adjust the liquid flows to the weir and spray nozzles. Weir flow rate should be 120 GPM. The flow rate to the spray nozzles should be between 31 and 62 GPM.

C.2. Refractory Curing Precautions

The refractory lining of the thermal processing equipment represents the single greatest cost item. It is important that certain precautions be observed so that a useful life can be expected from the lining. The refractories used in all Andersen thermal processing equipment represent selections based on many years of experience. These quality refractories, however, may still be contaminated, melted, or physically abused, thereby reducing their useful lives. The following discussion should be read and understood by all operating personnel before placing the system into operation.

a. Precautions

1. Always observe the refractory heat curing schedule before placing new thermal processing equipment into operation: The castable or gunned refractory in Andersen units is installed in a so-called "green" condition, i.e., the refractory is in an as-fabricated condition with a substantial water content. The refractory must be field-cured at a controlled rate to expel this moisture. Heat-up of a refractory lining at rates faster than those indicated on the curing schedules may result in explosions in which the refractory is physically blown away from its anchors. The curing schedule for the kiln (Ecomelt Generator), secondary combustion chamber, drop out box, melt section and duct-work is presented in the vendor manual behind tabs "Refractory Afterburner" or "Refractory Kiln". The cure schedule for the Ecomelt dryer is presented in the vendor manual behind tab "Refractory FEECO Dryer".

2. Do not subject the refractory to sudden temperature changes: Thermal shock due to rapid warm-up or cool-down cycle can destroy the refractory structure. This can be avoided by minimizing the rate of temperature change during warm-up/cool-down cycle of the refractory. Take the following precautions into consideration:

    a. When the unit is started from an extremely cold condition, where moisture condensation can accumulate and wet the refractory, the temperature should be brought up at a slow rate of 75°F per hour.

    b. If the unit is started from a preheated condition (250°F - 300°F), the temperature should be brought up at a rate not exceeding 100°F per hour.

3. Do not use water in the thermal processing equipment to attempt to put out any fires. Steam can be used, but not water.

4. Do not subject the refractory to mechanical shock: Removing ash or slag from the thermal processing equipment should not be done with tools having sharp or pointed ends. Open and close the cleanout and access doors gently.

5. Do not be alarmed by the appearance of random cracks in any monolithic lining. Like most materials, refractories have a temperature dependent coefficient of expansion. The formation of cracks is, therefore, natural. These cracks usually vary from 1 to 5 mm in width and are easily seen when the refractory is cool. At operating temperatures, the cracks close up. The first signs of any internal refractory damage can usually be detected from the appearance of white "hot" spots on the external steel shell.

b. Requirements Before Curing

Before curing the refractory, the thermal processing equipment, air cleanup, I.D. fans and water quenching systems must be fully operational. Andersen 2000 Inc. personnel, in accordance with the curing schedules, will conduct the refractory curing.

C.3. Ecomelt Generator System Preparation

a. Start the I.D. fan (B-304).

b. Start the Ecomelt Generator nose-cooling blower (B-207).

c. Start the Ecomelt Generator combustion air blower (B-201).

d. Start the secondary combustion chamber air blower (B-202).

e. Start the melt section combustion air blower (B-203).

f. Start the water-cooled auger/screw feeder (C-151).

At this point, the burners can be lit and the refractory curing procedure initiated. Andersen 2000 Inc. personnel will conduct this. During the initial curing period, the primary, melt section, and secondary burners will be firing with only the pilots on. Later on, the main burners themselves (HX-201, HX-202 and HX-203) will be cycled on and off until a point is reached at which the curing temperature has reached a level where the burners can be maintained at low fire. The kiln will be rotated in 45°-90° increments at first and then left on continuously. As the temperatures throughout the system increase, the water sprays in the quencher (Z-301) will be turned on. The quencher double tipping valves (KV-301 and KV-302) and the baghouse dust discharge rotary feeder (F-303) will be turned on. Firing of the melt section burners should be monitored to ensure that there is no flame impingement on the refractory walls or the tiles.

The combustion chamber refractory for the Ecomelt dryer will also have to be cured. The curing schedule for this refractory in presented in the Vendor Parts manual behind the "REFRACTORY FEECO DRYER" tab. Since the drum and down stream processing equipment are not refractory lined, a heat sink will be required during the curing cycle. Water can be used as the heat sink. Cascading and spraying water through the solids inlet chute would accomplish this. However, there is no way to contain the excess water, other than running it onto the ground. Another method is to use the wet, granulated product as the heat sink. The following procedure is based upon using wet, granulated product as the heat sink.

C.4. Ecomelt Dryer System Refractory Curing

a. Start the dried Ecomelt bucket elevator (C-217).

b. Start the Ecomelt conveyor (C-216).

c. Start the dryer discharge rotary feeder (F-206).

d. Start the dryer cyclone dust discharge rotary feeder (F-401).

e. Start the bag filter dust discharge rotary feeder (F-402).

f. Start the Ecomelt Dryer induced draft fan (B-402).

g. Start the Ecomelt Dryer drum (D-206)

h. Start the Ecomelt Dryer combustion air fan (B-206)

At this point, the burner can be lit to begin the refractory curing procedure. Andersen 2000 Inc. personnel will conduct this. During the initial curing period the burner will be at low fire. When the combustion chamber temperature reaches 200°F, wet granulated product can be introduced to act as the heat sink.

C.5. Raw Sediment Feed

a. Start the sediment / modifier mixer (M-131).

b. Start the weigh screw feeder (C-112).

c. Start the transfer conveyor (C-101).

d. Set the flow controller FIC-101 to 0 #/hr.

e. Start the raw sediment storage bin (screws) (T-101).

f. Set the vibe/belt feeder (F-104) to automatic.

g. Start the live bin bottom (V-104).

h. Set the vibratory feeder (F-103) to automatic.

Start the live bin bottom (V-103).

j. Change the set point of the flow controller FIC-101 to 500 #/hr. Slowly increase this to up to the maximum design flow rate of 3431.47 #/hr.

k. Start the lime eductor blower B-302.

l. Start the lime feeder airlock F-302A.

m. Set the volumetric feeder (F-102) to automatic.

n. Start the live bin bottom V-302.

This will eventually introduce raw sediment into the Ecomelt Generator, which will be processed and dropped into the granulator. This wet Ecomelt will then be discharged into the Ecomelt Dryer, acting as the heat sink to enable the refractory cure. The initial Ecomelt product produced will not be dry. This off-spec product should be removed from the Ecomelt hopper (T-219) and mixed back into either the raw sediment storage bin (T-101) or the alternate feed bin (T-102).

After the dryer's refractory has been cured, it is highly recommended that the system be shut down, allowed to cool (48 hours minimum) and then inspected for refractory damage or failure.

D. Normal System Start-up Procedures

D.1. Air Compressor (P-305) and Instrument Air Dryer

Start the compressor and allow unit to generate supply of compressed air. Start the plant air dryer by turning the switch to the "ON" position.

D.2. Scrubbing System Preparation

The quencher water tank (T-301) and the granulator recirculation tank (T-203) should be full of water and at their normal operating levels. All pump inlet, outlet and pipe rack valves must be open. The block valves for the pumps seal flush connection on the Ecomelt quencher water pump (P-203) must also be open.

All of the process controllers except the draft controller (PIC-201) should be in automatic mode. The draft controller (PIC-201) should be in manual at 0% output. This will close the I.D. Fan's inlet damper (PV-201). The set points for the burner temperature controllers (TIC-201, -202, -203 and -206) should be set to 200°F. The raw sediment flow controller (FIC-101) should be set to 0 #/hr. The system should be started up in the exact sequence presented below. Turn on the quencher water pump (P-301).

a. Adjust the water flow to the water-cooled auger / screw feeder (C-151) to 30 GPM.

b. Turn on the Ecomelt quencher water pump (P-203).

c. Adjust the liquid flows to the weir and spray nozzles. Weir flow rate should be 120 GPM. The flow rate to the spray nozzles should be between 31 and 62 GPM.

After starting up a pump, the operators should check the particular system for any problems and/or abnormalities.

D.3. Ecomelt Generator System Preparation

a. Start the I.D. fan (B-304).

b. Place the draft controller (PIC-201) in automatic.

c. Start the Ecomelt Generator nose-cooling blower (B-207).

d. Start the Ecomelt Generator combustion air blower (B-201).

e. Start the secondary combustion chamber air blower (B-202).

f. Start the melt burners combustion air blower (B-203).

g. Start the Ecomelt Generator drum drive (R-201).

h. Start the water-cooled auger / screw feeder (C-151).

D.4. Ecomelt Generator Warm-up

At this point, the burners can be lit and the refractory heat soaking begun.

a. Light the kiln burner.

b. Light the afterburner.

c. Light the melt burners.

d. Start the quencher double tipping valves (KV-301 and KV-302).

e. Start the baghouse dust discharge rotary feeder (F-303).

Slowly increase the temperature of each zone at 100°F per hour. As the temperatures throughout the system increase, the water sprays in the quencher (Z-301) will be turned on. Once the temperatures in the Ecomelt Generator (kiln), the melt section and the secondary combustion chamber (afterburner) reach their operating temperature, the Ecomelt dryer system and raw sediment feed systems can be started.

D.5. Ecomelt Dryer System Warm-up

a. Start the dried Ecomelt bucket elevator (C-217).

b. Start the Ecomelt conveyor (C-216).

c. Start the dryer discharge rotary feeder (F-206).

d. Start the dryer cyclone dust discharge rotary feeder (F-401).

e. Start the bag filter dust discharge rotary feeder (F-402).

f. Start the Ecomelt dryer induced draft fan (B-402).

g. Start the Ecomelt dryer drum (D-206).

h. Start the dryer combustion air fan (B-206).

i. Light the dryer burner.

When the Ecomelt dryer's combustion chamber temperature reaches 200°F, wet granulated product can be introduced to act as the heat sink.

D.6. Raw Sediment Feed

a. Start the sediment/modifier mixer (M-131).

b. Start the weigh screw feeder (C-112).

c. Start the transfer conveyor (C-101).

d. Start the raw sediment storage bin (screws) (T-101).

e. Set the vibe/belt feeder (F-104) to automatic.

f. Start the live bin bottom (V-104). Mod #2

g. Set the vibratory feeder (F-103) to automatic.

h. Start the live bin bottom (V-103). Mod #1

i. Change the set point of the flow controller FIC-101 to 500 #/hr. Slowly increase this to up to the maximum design flow rate of 3431.47 #/hr.

j. Start the lime eductor blower B-302.

k. Start the lime feeder airlock F-302A.

l. Set the volumetric feeder (F-302) to automatic.

m. Start the live bin bottom V-302.

This will eventually introduce raw sediment into the Ecomelt Generator, which will be processed and dropped into the granulator. This wet Ecomelt will then be discharged into the Ecomelt dryer, acting as the heat sink to enable warm-up of the combustion chamber's refractory. The temperature in the combustion chamber should be increased at a rate of 100°F per hour. The initial Ecomelt product produced will not be dry. This off-spec product should be removed from the Ecomelt hopper (T-219) and mixed back into either the raw sediment storage bin (T-101) or the alternate feed bin (T-102). When the dryer discharge temperature reaches 250°F, the Ecomelt product should be dry and "in spec". The combustion chamber temperature should be 1800° – 2000°F. The plant is now fully operational.

VII. OPERATIONAL GUIDELINES

General operational guidelines are set forth in this section and are intended to identify the key operational parameters and trends, of which plant operators should be aware.

1. **Operating Temperature Ranges**
   Crucial operating parameters include the Ecomelt discharge temperature (2550°F), Ecomelt dryer outlet temperature (250°F), and baghouse inlet temperature (350°). If any of the above temperature ranges are not possible to achieve, contact Andersen 2000 Inc. for assistance.

2. **Material Processing Rates**
   The processing rates associated with the plant are a function of the required temperatures necessary in each chamber as well as characteristics of the materials such as moisture content, clay content, gradation, etc. When processing materials that contain high levels and/or varying consistencies of contaminants, feed rates may need to be reduced to a level that allows the operator to maintain good control of chamber temperatures. The plant has been designed to process up to 2,931 #/hr of raw sediment. When mixed with the modifiers, the total waste and modifier feed rate will be up to 3431#/hr.

3. **Feed Rate Controller**
   During initial startup, a correlation should be developed between the control output level of the modifier feeder variable speed controls and the actual modifier feed rate. This will provide the relationship between modifier feed signal and actual #/hr feed rate. This will provide the relationship between feeder control signal and the actual feed rate to the Ecomelt Generator in pounds/hour.

4. **Beginning Feed to the Ecomelt Generator**
   As materials are introduced into the Ecomelt generator, the gas temperature will drop since the materials begin to absorb heat. As this happens, the burner output level should be adjusted to achieve the desired operating temperatures.

   NOTE: *Raw sediment feed must not be introduced into the Ecomelt generator until the Ecomelt generator, melt section and secondary combustion chamber have been properly pre-heated to their required operational temperature and the quench system fully operational.*

5. **Ecomelt Generator Rotational Speed**
   Rotational speed of the Ecomelt Generator controlled and altered by using the control for the variable speed drive. The operational rotation is expected to be 0.2 to 1.0 rpm. The required rotational speed is a function of the rate of materials processing, temperature, and material type. The recommended initial starting point for the Ecomelt Generator is 0.7 rpm. The unit can be operated with the burner output level held constant while using the feed rate and the Ecomelt

generator rotational speed controllers to alter and track the outlet temperatures. This helps to fine-tune the process.

6. **Ecomelt Generator Warm-Up**

During start-up, care should be taken to assure that the system is not heated too quickly as the components and ductwork will absorb heat and expand slightly. The Ecomelt generator exhaust gas temperature should be elevated from ambient temperature at a rate of 100°F per hour.

7. **Ecomelt Generator - Draft**

During operation, the system draft should be modulated as necessary to maintain a burner suction of -0.2 to -0.3 inches water column as indicated on the "PIC-201" indicator. This suction is measured by a dP cell which monitors pressure at the port located at the burner end plate, left of the Ecomelt Generator burner. Too low of burner suction draft will cause overheating of drum shell and "puff-back" through drum seals. A low draft is desirable from the standpoint of minimizing the volume of airflow through the system, thus maximizing production rate capacity. Too high of a draft will cause more excess air than necessary to be pulled in through the drum seals. This will contribute to an inefficient process and production rate limitations. The Ecomelt Generator must be kept under a slight negative draft at all times, as described above.

Access to the secondary combustion chamber platform should be blocked once the Ecomelt Generator burner (HX-201) or melt section burners (HX-203) are lit. This area will be hot and could lead to bodily injury or even death to a person in this area while these burners are in operation.

8. **Material Discharge Temperature**

The temperature selected for material processing has been determined by ENDESCO Clean Harbors. However, the unit should be operated with the lowest temperature found to slag (melt) the raw sediment and modifier mixture. Another parameter that will have an effect on the material processing is drum speed. The rotational speed of the drum can be used to retard the advancing motion of the material and increase retention time.

9. **Ecomelt Quencher and Granulator**

The material cooling water injection system consists of a pipe lance fitted with five (5) spray nozzles and four (4) plugged couplings. The total number of nozzles can be changed as required to solidify the slagged material as it drops into the granulator conveyor. Total liquid flow to the spray nozzles can be adjusted with a valve in the feed piping. Two rotameters have been provided to monitor the water flow to the spray nozzles and the overflow weir.

10. Secondary Combustion Chamber Warm-Up

During start-up, care should be taken to assure that the system is not heated too quickly. The secondary combustion chamber exit gas temperature should be elevated from ambient temperature at a rate of 100°F per hour. As the secondary combustion chamber burner level is changed, the system draft will be affected and should be adjusted to maintain a burner suction of -0.2 to -0.3 inches water column as indicated on the "PIC-201" indicator. Contaminated materials must not be introduced into the Ecomelt Generator until the Secondary Combustion Chamber has been properly pre-heated to the required operational temperature.

11. Secondary Combustion Chamber Temperature Variations

During operation, vaporized contaminants will be received by the secondary combustion chamber where they are oxidized by the elevated temperatures. When the contaminants oxidize, energy is released which will *add* to the energy being supplied by the secondary combustion chamber burner. As the concentration of these vaporized contaminants changes, temperature swings will occur which will be compensated for by the secondary combustion chamber burner controller, when in the automatic control mode. If the burner control system is not in the automatic control mode, the operator must monitor the secondary combustion chamber outlet temperature and adjust the burner output accordingly. As operator skill is gained, along with knowledge of material conditions, temperature swings will be minimized in the secondary combustion chamber.

12. Oxygen / Contaminant Oxidation

Changes in the Ecomelt Generator combustion air supply may be necessary to assure that enough oxygen is available for contaminant oxidation when high contaminant levels are being processed. This can be achieved by altering the position of the Ecomelt Generator combustion air damper (AV-103). This adjustment is done by the combustion air damper controller "FY-103". The minimum oxygen content of the gas stream exiting the Ecomelt Generator should generally be in the range of 2.5% to 3%.

13. Quencher Exit Temperature

The system cooling chamber serves to reduce the temperature of the gases entering the baghouse. The critical parameter associated with the cooling chamber is the baghouse inlet temperature. The exit temperature of the Quencher should be 350° not to exceed 400°F and should be monitored for cooling system performance.

14. Quencher Nozzle Inspection

Periodic inspection of the injection nozzles should be performed on a regular basis along with manual cleaning to remove deposits, when needed. Excessive material build-up in the Quencher chamber can be the result of a reduction in the degree of atomization of the quench water. When good atomization is not achieved, the water droplets may not be fully evaporated by the time the spray

pattern contacts the chamber walls. If the water spray contacts the chamber walls, material build-up will result.

NOTE: *Extreme care should be exercised when cleaning accumulations from the interior of the Quencher chamber due to the possibility of materials breaking loose from the upper portion and falling on personnel working in the lower portion.*

15. Baghouse Inlet Temperature

There are several critical parameters associated with operation of the baghouse. The most important of these is the gas inlet temperature to the baghouse which must not exceed 400°F.

16. Baghouse Exit Temperature

The baghouse should be operated so the exit gas temperature does not fall below around 335°F. This is particularly important when processing materials containing either halogenated or sulfided compounds since these materials will tend to condense out of the gas stream and cause corrosion of the interior surfaces of the baghouse, duct, fan and stack.

17. Baghouse Pressure Differential

The operator should monitor the baghouse pressure drop which is the pressure differential across the tubesheet. This pressure will vary across a specified range which activates the pulse-jet cleaning system. The pressure drop (dP) across the tube sheet should typically run at 6 inches water column. The air pressure for this system should be 80-95 psi in the baghouse cleaning manifold.

18. Testing for Baghouse Leaks

To assure that there are no leaks in the baghouse, blacklight dust can be distributed into the baghouse. After distributing the dust and operating the draft fan for a short period of time, stop the fan and open the top access doors. This allows access to the clean side of the tube sheet which can then be checked, using a blacklight, for signs of the dust. This method is used to identify leaking bags, improperly seated bags, and/or leaks in sidewalls. This should always be done prior to a stack test and whenever there is a concern that the expected particulate collection efficiency is not being achieved.

19. Lime Injection System

The lime injection system should be checked for pluggage or loss of lime flow. If the pipe lines are plugged, the pipes would rapidly cool off, which could be checked by a surface thermometer. The only way to determine lime bridging is to monitor the lime hopper level indicator (LI-302) over a long period of time. No change or very little change would indicate lime bridging or pluggage.

20. Activated Carbon Bed

The activated carbon bed is a passive system with no operator involvement. The vessel should be visually checked with an IR gun to check for hot spots.

21. Air Compressor

The plant air compressor supplies air for several functions. The general pressure ranges for the main compressed air functions are listed below:

Air Operated Control Valves	20-25 psig
C.E.M.S.	80 psig
Opacity	70-100 psig
Quencher Atomizing Air	40 psig at nozzles (PCV-304 set @ 50 psig)
Baghouse Cleaning Air	80-95 psig
Bin Vent Filters Cleaning Air	80-95 psig

VIII. SHUTDOWN PROCEDURES

A. Normal Shutdown

The operator can stop the feed and cool the plant down by individually controlling the system components. When the feed is stopped, the remaining material inventory in the kiln must be processed. Once the last of the material has been treated, the burners will both be modulated to slowly cool the thermal processing equipment.

The system should be shutdown in a manner to allow the materials and gases to be held at the appropriate operating temperatures until all the materials have passed through the system. Whether operating in the automatic or manual modes, system shutdown should be accomplished in the following sequence:

1. Stop raw sediment feed by turning off either the raw sediment storage bin screws (T-101) or the alternate feed bin screws (T-102).

2. Stop the vibratory feeder (F-103) and the live bin bottom (V-103) for the modifier #1 hopper.

3. Stop the vibe / belt feeder (F-104) and the live bin bottom (V-104) for the modifier #2 hopper.

4. The operator must now wait until the material from all of the screw conveyors has been emptied. When the weigh screw feeder flow indicator (WIT-112) shows "0 #/hr", the operator can proceed.

5. Stop the transfer conveyor (C-102) if it was running.

6. Stop the transfer conveyor (C-101).

7. Stop the weigh screw feeder (C-112).

8. Stop the modifier #1 conveyor (C-103).

9. Wait 5 minutes or until no more material is being fed into the Ecomelt Generator and then stop the sediment/modifier mixer (M-131). The operator can listen for a change in the noise emanating from the equipment that would indicate no material flow. This should be verified visually through the view port at the discharge end of the Ecomelt Generator.

10. The primary, afterburner and melt burners should still all be in automatic. The temperature set points for each burner should be slowly reduced. The ideal cooling rate is 100°F per hour.

11. The Ecomelt dryer system will also have to be shut down. Shut down procedures for this system starts at instruction No. 23.

12. Stop the volumetric feeder (F-302), the live bin bottom (V-302) and the lime feeder airlock (F-302A).

13. Stop the lime eductor blower (B-302).

14. Once the temperature entering the quencher (Z-301) is below 300°F, the primary, afterburner and melt burners should be turned off.

15. Turn off the burner combustion air fans B-201, B-202 and B-203.

16. Turn off the induced draft fan B-304.

17. Turn off the double tipping valves KV-301 and KV-302 and the dust discharge rotary feeder F-303.

18. Once the temperature inside the Ecomelt Generator has dropped below 190°F, the water-cooled auger / screw feeder (C-151), the nose cooling blower (B-207) and the Ecomelt Generator drive (R-201) can be turned off.

19. Stop the Ecomelt quencher water pump (P-203) and the quencher water pump (P-301).

20. Turn off the opacity blower.

21. Turn off the C.E.M. and drain all the water from the condenser inside the enclosure if the ambient temperature will get below freezing.

22. Turn off the air compressor (P-305), vent the compressed air and drain the receiver tank (T-305).

23. Eventually, no more material will be processed through the Ecomelt Generator and into the granulator. As the material feed into the dryer is decreased, the dryer burner firing rate will be decreased. When the combustion chamber temperature drops below 250°F, the burner can be turned off.

24. When all of the material has been removed from the dryer drum, it can be turned off.

25. Stop the Ecomelt Dryer induced draft fan (B-402).

26. Stop the Granulator (C-203).

27. Stop the wet granulated Ecomelt conveyor (C-205).

28. Stop the wet Ecomelt rotary feeder (F-205).

29. When all of the material has been removed from the dried Ecomelt conveyor C-216, the rotary feeders, F-206, F-401 and F-402, can be stopped.

30. Stop the dried Ecomelt conveyor C-216.

31. When the dried Ecomelt bucket elevator is empty, it can be stopped.

B. Power Failure Shutdown

It is extremely important to verify that emergency power is available to the rotary kiln drive (R-201), the nose cooling blower (B-207), the Ecomelt Generator combustion air blower (B-201), the granulator (C-203), the quencher water pump (P-301) and the Ecomelt quencher water pump (P-203) in the event of power failure. The Motor Control Center (MCC) has been configured so that these motors are supplied power from a separate feeder, which is connected to a transfer switch for emergency power.

In the event of power failure, everything shuts down and everything goes to the fail-safe position. An uninterruptible power supply (UPS) should be installed (by others) to maintain power to the control computers and the programmable logic controller (PLC) systems.

Upon power failure, the emergency generator (by others) will start and the automatic transfer switch (ATS) will energize the feeder for these motors. The operator must then start these items as follows:

1. Start the quencher water pump (P-301) and the Ecomelt quencher water pump (P-203).
2. Start the Ecomelt Generator combustion air blower (B-201).
3. Start the Ecomelt Generator nose-cooling blower (B-207).
4. Start the rotary kiln drive (R-201).
5. Start the granulator (C-203).

When power is restored, the operator should go back to Section VI to determine how to restart the system.

C. Alarm Shutdown

If an emergency occurs with any of the equipment due to mechanical failure and/or an alarm condition, the PLC control system initiates an automatic shutdown of the

appropriate burner or the equipment associated with the failure. The cause for this shutdown should, therefore, be immediately investigated. Tips for troubleshooting the system are provided in Section XVI. The operator should not simply reset an alarm to restart the system. The cause and source of the alarm should be fully investigated and corrected prior to restarting the system.

During an alarm shutdown, both Ecomelt Generator and the Secondary Combustion Chamber burners will automatically shut down. If the source of the shut down occurs in the incinerator or related components, the quenching system will continue to operate so that any residual flue gases in the incineration system can be cooled and cleaned prior to discharge to the atmosphere. If the source of the alarm occurs in the quenching system, the stack cap will open and the I.D. fan (B-304) will be shut down to protect the equipment from temperature damage.

D. Emergency Stop

Only under extreme emergency conditions should this shutdown procedure be used. The entire incineration and scrubbing system can be shutdown by pushing the "Emergency Stop" pushbutton on the local panel.

If the system is stopped in this condition for an extended period, it is quite likely that the kiln will experience thermal damage since it does not continue to rotate. Therefore, it is important that the kiln drive motor be reactivated as soon as possible so that the kiln does not remain in a static condition. This can also create some rather serious problems with clinker buildup in the kiln and with a number of other conditions that should be avoided except in extreme emergencies.

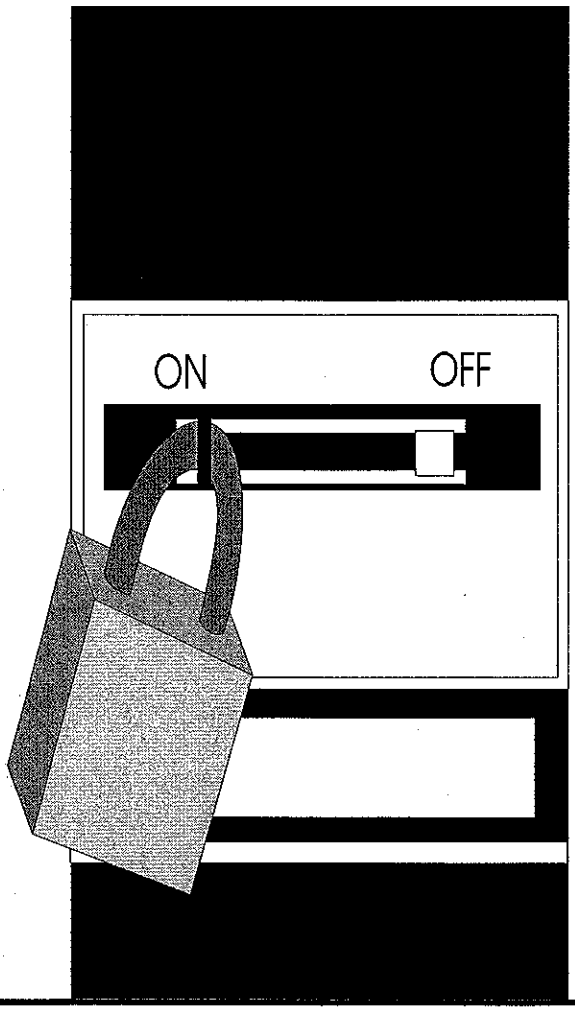
IX. SAFETY

RECEIVING MACHINE

Upon receipt of the machine, before unloading, carefully inspect for any loss or damage that may have occurred during transportation.

If any loss or damage is discovered, immediately notify the company's transportation agent who will give you the proper forms for making a claim.

SAFETY



READ THIS OPERATION AND SERVICE MANUAL
KNOW WHAT YOU ARE DOING

Safety is basically common sense. There are standard safety rules, but each situation has its own peculiarities which cannot always be covered by rules. Therefore, be ever watchful for safety hazards and correct deficiencies promptly.

Lack of attention to the notes and instructions in this manual can result in: accidents, personal injury, reduction in efficiency and, worst of all, loss of life.

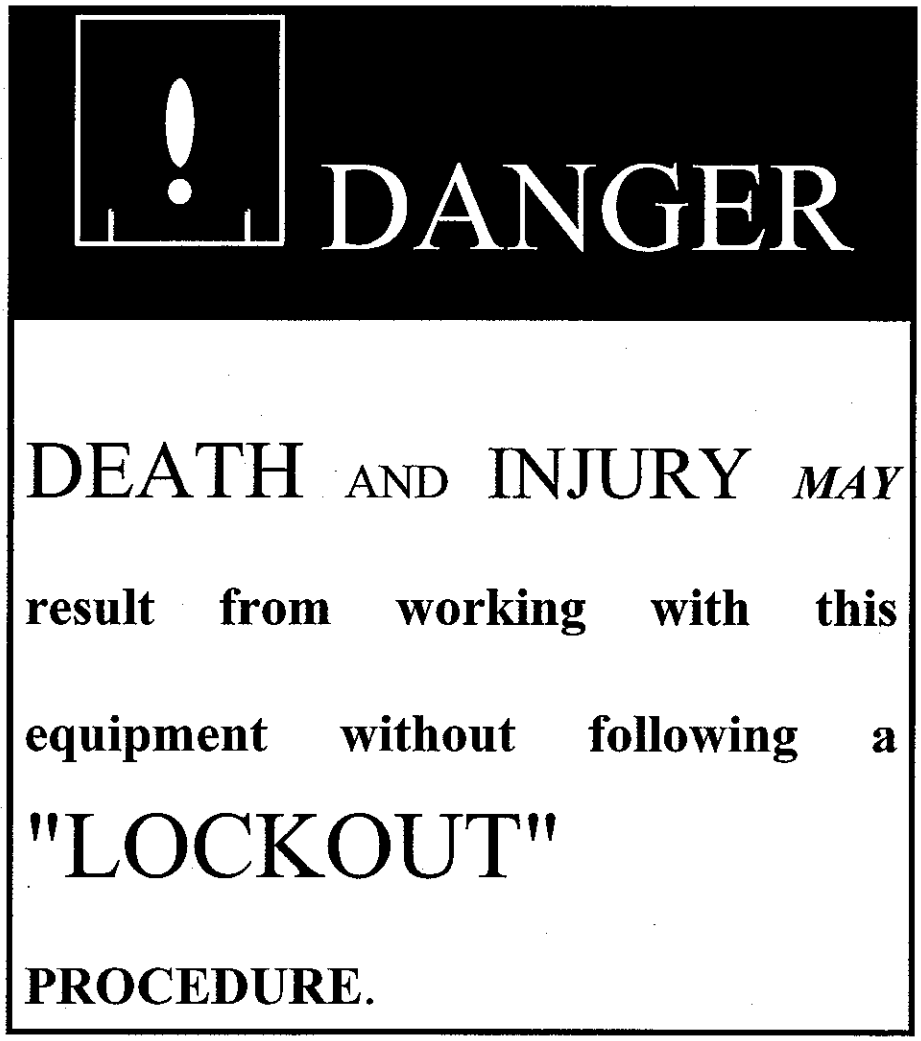
A careful operator is the best insurance against an accident.

THE COMPLETE OBSERVANCE OF ONE SIMPLE RULE WOULD PREVENT MANY THOUSANDS OF SERIOUS ACCIDENTS EACH YEAR.

THAT RULE IS:

Never Attempt to Clean, Oil, or Adjust any Machine or Machine Part Unless it is Stopped and Properly Locked Out with Your Personal Padlock to Insure that the Machine Cannot be Inadvertently Restarted.

This symbol is used throughout this manual and on safety signs to call attention to safety instructions. These instructions are of great importance and must be obeyed.



See Lock-Out / Tagout section for information on **"LOCKOUT"** procedures.

The safety of people and equipment is of great importance. Signs have been provided, as well as guards and other safety features for your protection. In addition, be careful and properly use and service your equipment.

WARNING:	Before attempting to work with this equipment, carefully read and follow the instructions given in this manual and by service technicians. If there are any questions on the safe operation and maintenance of this equipment, contact Andersen 2000 Inc.

1. KEEP AWAY from power driven parts unless they are properly locked out and rendered inoperative. Lock out power (unless instructed differently in this manual) before working on or near equipment for any reason. Use extreme caution if you must approach powered equipment.

2. ALWAYS USE normal start-up, operating and shutdown procedures as listed in this manual.

3. BE SURE the machine is in good operating condition and that all safety devices are installed and functioning properly.

4. KEEP items such as shirt sleeves, shirt tails, and long hair properly confined. Avoid wearing items such as wrist watches, rings, necklaces, and neckties.

5. WEAR personal protective equipment appropriate to the job conditions.

6. ACCOUNT for each person before starting any equipment. Use start-up alarm.

7. KEEP all spectators and other workers away from equipment while in operation.

8. DO NOT ALLOW people in areas where material might fall on them (e.g. under discharge points, under bypass chutes, near conveyors).

9. ALLOW only responsible, owner authorized, properly instructed individuals to operate the equipment. Carefully supervise inexperienced operators. New operators should be properly trained and supervised.

10. DO NOT ADJUST MOVING EQUIPMENT while operating. Use lockout procedures when maintenance or adjustments must be performed on moving equipment.

WARNING: 	See the Section 5 Installation for specific procedures regarding conveyor adjustments (pulley adjustment, belt tracking, etc.).

11. NEVER leave the Control Station unattended when any equipment is running.

12. MAKE NO MODIFICATIONS to your equipment unless specifically recommended or requested by Andersen 2000 Inc.

13. NEVER defeat the safety features of this equipment. (e.g., Never jumper around interlocks.)

14. AVOID suffocation. Do not walk on material in Feed Bins, as material surfaces might collapse.

15. DO NOT ENTER PTU drum, breechings, STU chamber or other confined spaces without adhering to approved procedures for entering confined areas without breathable atmosphere.

16. USE precautions for flammable materials.

17. STAY on designated work platforms to avoid falls. If work must be done in other areas use appropriate safety belts or other equipment.

18. AVOID high-pressure fluids. (e.g. hydraulic fluid/air). Escaping fluid under pressure can penetrate the skin causing serious injury. Relieve pressure before disconnecting hydraulic or other lines. Tighten all connections before applying pressure. Keep hands and body away from pin holes and nozzles which direct fluids under high pressure. Use a piece of cardboard or paper to search for leaks. Do not use you hand.

DANGER: 	If any fluid is injected into the skin, it must be removed within a few hours by a doctor familiar with this type of injury or gangrene may result.

19. DO NOT ALLOW people in areas where hot surfaces and/or radiated heat might present a safety hazard. Be extremely careful around material feed and discharge chutes. These can cause injury if contact is made with hot materials and/or hot surfaces. Being near the material feed and discharge openings is extremely dangerous if flammable conditions are created witin the process. Dangerous conditions can be encountered without warning.

20. CHECK the legibility of all safety signs every day; order new signs if they need to be replaced.

NOTE: 	All hazards cannot be foreseen or warned against: therefore, always be aware of and watchful for safety hazards.

X. EQUIPMENT LUBRICATION

IMPORTANCE OF LUBRICATION

Nothing can add to the life of the system more than thorough lubrication of the moving parts, properly executed at the correct intervals. When time and availability of the machine are at a premium, it is absolutely inexcusable to have a breakdown resulting from improper lubrication, since this can so easily be avoided. A normal lubrication schedule should be established for all the equipment components in this system. The vendor manuals previously supplied list lubrication schedules for each of the component parts. Refer to all manuals and vendor Parts manuals to become thoroughly familiar with the components and parts contained in the entire system.

NOTE: Lubricate only as directed in the lubrication chart and parts manual.

ANTI-FRICTION BEARINGS

The anti-friction bearings used on the support system have been lubricated at the factory. The grease cannot be seen since it is concealed within the bearing by the grease retainer seals.

Over-greasing distorts and damages these seals allowing dirt to enter and greatly shorten the life of the bearing.

NOTE: Never use a power operated grease gun on anti-friction bearings.

LOCAL ASSISTANCE

At the site of operation, identify local petroleum suppliers and contact them for guidance on available lubricants. Refer to the lubrication chart in this section for specific lubricant requirements.

GENERAL LUBRICATION PROCEDURES

If proper lubrication procedures are followed, lost time will be minimized and the life of equipment parts will be increased. Personnel responsible for equipment lubrication must understand the following general lubrication procedures:

1. Keep all grease guns clean and wipe grease fittings with a clean cloth to prevent grit from being pumped into the bearings.

2. Keep all grease and oil containers clean with their covers in place *(except when using)* to keep dust and dirt out of the lubricant.

3. Keep each lubricant container well labeled and make no mistake in using the correct lubricant in the right places.

4. Study all lubrication charts and instructions. Do not guess when lubricating any component. Call the manufacturer, if necessary.

5. Keep all components as clean as possible and remove any excess grease and oil which may accumulate during the day.

DANGER: 	Lubricants leaking from fittings, gearboxes, etc. can create personnel hazards.

6. When lubricating ball or roller bearings be extremely careful not to rupture the bearing seals through over-greasing.

ACCESS TO LUBRICATION POINTS

In some cases, it can be advantageous to "customize" a plant by attaching copper tubing to the grease fittings common to a particular area and running them to an easily accessible area. This creates a lubrication point "bundle" which can simplify the lubrication procedure. This procedure can reduce access problems.

DANGER: 	Never adjust, lubricate or work on any equipment or components without proper Lock-Out procedures and Confined Space working provisions in place. (See Lock-Out, Confined Space and Safety Sections of this manual)

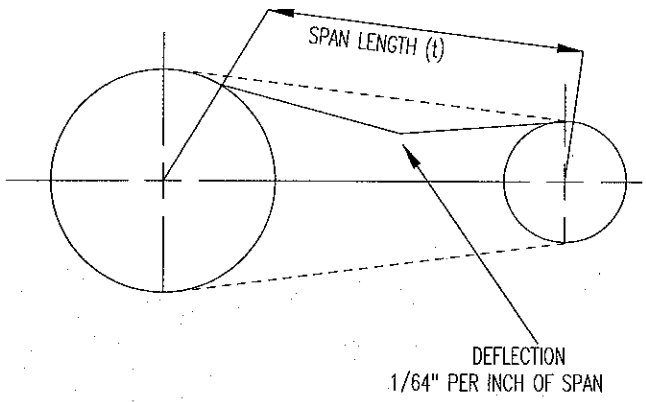
XI. KILN AND SUPPORT TRUNNION ALIGNMENT

XII. DRIVE BELTS

V-BELT CROSS SECTION	AVERAGE SMALL SHEAVE DIA. RANGE	DRIVE RANGES SMALL SHEAVE RPM RANGE	SPEED RATIO RANGE	RECOMMENDED BELT DEFLECTION FORCE - POUNDS PER BELT		
				FOR NORMAL TENSION	FOR 1.5X NORMAL TENSION	FOR 2X NORMAL TENSION
3V	2.65"-3.5"	1200-3600	2.00-4.00	3 Lbs.	4½ Lbs.	6 Lbs.
3V	4.75"-6.0"	900-1800	2.00-4.00	4	6	8
C5V	7.1"-9.0"	600-1500	2.00-4.00	8	12	16
5V	12.5"-16.0"	400-800	2.00-4.00	10	15	20
8V	18.0"-22.4"	200-700	2.00-4.00	20	30	40

ADJUSTING V-BELT TENSION

NOTE: V-belts must not be stretched over the rims of sheave grooves. Reduce the span between sheaves enough to permit the belts to be installed or removed without stretching.



ADJUSTING 3V-5V-8V SECTIONS

1. When assembling new belts, tighten them to about two times normal tension. There will be rapid drop in tension during the "run-in" period (first 24 to 48 hours) while the belts seat themselves in grooves. After the first day or two a check should be made for the correct amount of tension in each belt. If belt deflection force is over 1.5 times normal the belts are too tight. If the force is below normal belt tension, they are too loose.

2. *Adjustment Procedure:*

   Step 1. Measure the span length (t) of your drive.

   Step 2. At the center of the span (t) apply a force perpendicular to the span, large enough to deflect one belt on the drive ***1/64" per inch of span length*** from its normal position.

XIII. CHAINS AND SPROCKETS

DRIVE CHAINS

To insure the dependability and optimize the performance of chain drives, it is necessary to anticipate when chain replacement is required. Careful monitoring of the condition of drive chains can help avoid unnecessary down-time due to unexpected equipment failures. The service lives of chains and sprockets are affected by chain wear, lubrication, metal fatigue, overload or shock load conditions and elongation factors.

ECOMELT GENERATOR DRIVE CHAIN LUBRICATION

The Ecomelt Generator and Ecomelt Dryer drive chains should be oiled daily. The proper procedure is to swab the chain with oil using a bucket and mop. The oil should be SAE 30 motor oil or API-GL5 80W90.

DRIVE CHAIN ELONGATION

Even when the chain is well lubricated, chain wear will still eventually take place. Greater clearance between the pin and bushing (as well as metal fatigue) results in chain elongation. After the chain is elongated, it will ride higher on the sprocket and may jump teeth. Elongation may be measured by removing slack from the slack side and measuring several links on the tight side of the chain. If elongation exceeds 2½% of the original pitch, the chain should be replaced. For a 65" strand of chain, measured length should not exceed 66-5/8". If this occurs, replace the chain.

DRIVE CHAIN BREAKAGE

Although chain breakage can be temporarily repaired to avoid a long shut-down, the entire chain should be replaced as soon as possible. Whether the reason for failure of one section is fatigue or a single overload condition, other sections of the chain have probably been weakened by the same condition and another failure is likely to occur and can occur at the least opportune time.

ECOMELT GENERATOR DRIVE SPROCKET

Before installing a new PTU drive chain, inspect the sprocket teeth to see if they are worn to a "hooked shape". If this condition exists, chain life will be greatly shortened. As a temporary measure, sprockets may be reversed. However, the tooth's ability to withstand the forces in the chain drive has been weakened and problems can result if the sprocket is not replaced soon. When installing a new chain, check the alignment of sprockets to avoid unnecessary wear.

CHAIN TENSION

Adjust chain tension so that chain slack is approximately equal to 2% of the sprocket centers. Installing the chain too tightly increases sprocket wear and may overload the shaft bearings. A chain that is too slack produces vibration that may result in excessive chain wear, noise or shock loading. If the drive is experiencing shock loading, tensioning should be to the point where the chain is almost taut. It is essential to inspect such drives regularly for correct chain tensions.

IMPORTANT: 	Never adjust or work on any of the drive equipment or other components without proper lock-out procedures in place. (see Lock-Out Sections of this manual)

XIV. I.D. FAN AND BLOWERS

FAN INSPECTION

Inspect the induced draft (I.D.) fan and burner combustion air blowers periodically during operation, whenever unusual noise or vibration is detected, and before start-up following an extended shut-down. Check for material accumulation, corrosion, worn or loose parts, and/or water accumulation in housing. Monitor the induced draft fan for accumulations of condensed oils. This type of accumulation must be minimized by continuous drain lines.

FAN VIBRATION

Fan vibrations can be caused by:

1. Build up of dust or foreign matter on the wheel.
2. Loose bolts on bearings, housing and drive.
3. V-belt drives improperly aligned or tensioned, or sheaves not in balance.
4. Bearing clearance and/or improper alignment.
5. Fan wheel loose on its shaft.
6. Fan wheel, shaft or bearings damaged (possibly by foreign matter entering the fan).
7. Fan wheel shifting on its shaft, resulting in improper clearances.

If fan vibrations cannot be corrected, the fan may need balancing. Fans should only be balanced by qualified personnel. Contact Andersen 2000 Inc. for further assistance.

DANGER: 	*Do not operate an unbalanced, worn or damaged fan., It can fail catastrophically, showering a large area with high speed shrapnel.*

OTHER SOURCES OF VIBRATION

Factors to consider other than the fan include the following;

A. Can vibrations be attributed to a flittering damper?

B. Does the vibration continue when the drive belts are removed and the motor is run by itself?

C. Does the vibration continue when the fan is stopped?

WARNING: 	*Do not operate fans without all guards, access doors and drain lines in place. Avoid contact with rotating components; lock out power before doing any inspection or maintenance that might lead to contact.*

PROLONGED SHUT DOWN

If the draft fan and burner blowers are to remain idle for an extended period, protect exposed surfaces with a suitable coating. Rotate the shafts periodically to prevent corrosion in the bearings. Remove drain plugs to prevent water or other condensate from accumulating in the housings. Cover any inlets and/or outlets which could be exposed to rain infiltration.

XV. EQUIPMENT INSPECTION AND MAINTENANCE

In order to keep the equipment operating properly and to avoid downtime, ENDESCO Clean Harbors (ECH) should establish a preventive maintenance and lubrication schedule. This schedule, performed properly and carried out on time, will prolong the life of the rotary kiln melter and equipment. This section contains a recommended preventive maintenance and service guide and a recommended lubrication schedule.

In addition to a fully equipped tool box, you should also have available the following tools and instruments:

1. A 30" H_2O differential pressure gauge with flexible tubing to both high and low pressure ports.

2. A 0-60 psig pressure gauge with Type 316 S.S. Bourdon tube.

3. A digital multimeter with current transformer accessory to enable amperage readings on running motors.

4. A vibration detector and analyzer.

5. A surface temperature thermocouple and indicator with 0-500 range.

6. A "gun type" I.R. temperature reading instrument.

7. Adequate supply of pH buffer solutions (pH = 4 and 7)

This maintenance section of the manual must be supplemented with the information contained in the "vendor parts manuals" that accompanies this manual. The vendor parts manuals contain detailed information on maintenance guidelines for specific components parts. Andersen 2000 Inc. urges ENDESCO Clean Harbors to develop a written inspection and maintenance program that is available to all maintenance personnel and all system operators.

A. Daily Maintenance

1. Kiln, Afterburner, Drop Out Box, Ducts and Quencher. Using the I.R. gun-type heat detector, verify the surface temperatures of these items. Visually check through the site glass at the end of the kiln and secondary combustion chamber and on both sides of the melt section burners to insure that the refractory has not been damaged and to insure that there are no clinker buildups or slag buildups.

2. Granulator. In conjunction with the inspection of the rotary kiln melter, the product from the granulator should be checked. Ecomelt Generator operating parameters may have to be adjusted to change the quality or quantity of the Ecomelt product.

These parameters are temperature, drum speed, sediment feed rate, and modifier feed rates.

3. Water Quenching Systems. Verify the liquid flows to the water-cooled auger / screw feeder (C-151) and to the weirs and spray nozzles in the melt section.

4. PLC and CEM Systems. Review all PLC setpoints from the console and verify that all alarms and annunciators are functioning properly. Check all temperature, pressure, and flow set points on the PLC system. Review the alarm log and report any alarms that must be reported to the regulatory agency. This would include excursions recorded by the CEM system or temperature or pressure alarms in the PLC system. Check also to be sure that the CEM is functioning properly and that the daily calibration values are recorded.

5. Quencher (Z-301). Verify the liquid flow rates to the spray nozzles. Check to be sure that the double tipping valve below the cone is operating properly and is not plugged.

6. Baghouse (S-303). Visually inspect the cladding and insulation and repair any damage found. Check to be sure that the discharge valve is operating properly and is not plugged. Check the differential pressure across the unit and verify that the cleaning cycle is working properly.

7. Activated Carbon Bed. Using the I.R. gun-type heat detector, check the surface temperature. Verify that there is fire water supply to the emergency quench nozzles in this vessel.

8. I.D. Fan and Lime Eductor Blower. Check these fans for vibration using a vibration analyzer. Check the fan bearing temperatures using a surface temperature detector. Please note that over-lubrication of the bearings causes excessive temperature. If temperatures are excessive, do not lubricate the bearings until it has been verified that they do not have adequate lubricant in them.

9. Combustion Air Fans and Nose Cooling Fan. Check these fans for excessive vibration.

10. Ecomelt Dryer. Using the I.R. gun-type heat detector, check the surface temperature of the combustion chamber and the drum.

11. Bag Filter. Check to be sure that the discharge valve is operating properly and is not plugged. Check the differential pressure across the unit and verify that the cleaning cycle is working properly.

12. Ecomelt Dryer Induced Draft Fan. Check this fan for excessive vibration.

13. Oil the main rotary kiln melter chain drive daily (R-201)

TABLE XV-A DAILY CEMENT-LOCK INSPECTION REPORT				
ITEMS TO BE INSPECTED	**RESULTS**		**CORRECTIVE ACTION**	
	PRESENT	**NOT PRESENT**	**NEEDED**	**DATE ACCOMP.**
Kiln, Afterburner, & Drop Out Box				
Duct or Breeching Flange Leaks	±			
Burner Connection Leaks	±			
Rotary Kiln Melter Chamber Leaks	±			
High Rotary Kiln Melter Chamber Temperature	±			
Kiln, Afterburner, Drop Out Box, Ducts Excessive Temperatures	±			
Refractory Damage	±			
Clinkers Present	±			
Low Rotary Kiln Melter Chamber Temperature	±			
Sediment Feed Systems				
Raw Sediment Storage Bin T-101 Flange Leaks Abnormal Noise	± ±			
Alternate Feed bin T-102 Flange Leaks Abnormal Noise	± ±			
Transfer Conveyor C-102 Flange Leaks Abnormal Noise	± ±			
Weigh Screw Feeder C-112 Flange Leaks Abnormal Noise	± ±			

TABLE XV.A DAILY CEMENT-LOCK INSPECTION REPORT				
ITEMS TO BE INSPECTED	**RESULTS**		**CORRECTIVE ACTION**	
	PRESENT	**NOT PRESENT**	**NEEDED**	**DATE ACCOMP.**
Sediment / Modifier Mixer M-131 Flange Leaks Abnormal Noise	± ±			
Water Cooled Auger / Screw Feeder C-151 Flange Leaks Abnormal Noise	± ±			
Vibe / Belt Feeder F-104 Flange Leaks Abnormal Noise	± ±			
Vibratory Feeder F-103 Flange Leaks Abnormal Noise	± ±			
Air Pollution Control System				
Double Tipping Valves Plugged	±			
Proper Cooling Water Flow – Auger		±		
Air Compressor Oil Level		±		
Air Compressor Air Leaks	±			
Air Compressor Abnormal Noise	±			
Water Tank Leaks	±			
Adequate Water Pressure		±		
Adequate Compressed Air Pressure		±		
Proper Water flow to Melt Section – Weirs		±		
Proper Water Flow to Melt Section - Sprays		±		

TABLE XV.A DAILY CEMENT-LOCK INSPECTION REPORT				
ITEMS TO BE INSPECTED	RESULTS PRESENT	 NOT PRESENT	CORRECTIVE ACTION NEEDED	 DATE ACCOMP.
Quencher Water Flow – Adequate		±		
Baghouse (S-303) High dP	±			
Activated Carbon Bed Hot Spots	±			
Fire Water Supply to Activated Carbon Bed	±	±		
I.D. Fan – Excessive Vibration	±			
I.D. Fan – High Bearing Temperature	±			
Lime Eductor Blower – Excessive Vibration	±			
Lime Eductor Blower – High Bearing Temperature	±			
Combustion Air Fans Excessive Vibration	±			
Nose Cooling Fan Excessive Vibration	±			
Bag Filters (S-402) High dP	±			
Ecomelt Dryer – Excessive Temperature	±			
Ecomelt Dryer Induced Draft Fan – Excessive Vibration	±			
High dP on Quench	±			
Compressed Air Regulators Set		±		
Drain all compressed Air Drain Cocks of Water				
PLC and CEM Systems				
All Alarms & Safeties Need To Be Checked		±		

High CO	±			
Low O_2	±			
Computer Display		±		
Signature of Inspector: _____ Date:				
Note: All checks within circles must be addressed under "Corrective Actions".				

B. Weekly Maintenance

1. Kiln, Afterburner, and Cyclone. Verify that all air supply fan intake filters or screens are opened and cleaned. Check the entire kiln shell and afterburner shell for hot spots that would indicate refractory problems. Check the seals at the feed end and discharge end of the kiln for leakage and wear. If there is substantial wear on the wear materials, schedule a replacement at the earliest possible opportunity. Check the kiln tires and the four kiln trunnions for wear that would indicate kiln misalignment. If there is substantial wear occurring, realign the kiln in accordance with the procedures described in Section XI. Check the kiln drive chain to insure that it is being lubricated routinely and correctly. Check the high temperature expansion joint in the ducting from the afterburner to the quencher to insure that it has not been damaged and to insure that it is not leaking.

2. Burners. Verify all burner safety functions from the burner safety panels. There is a separate burner safety panel for each burner area.

3. Air Pollution Control System. Calibrate the pH electrode in the granulator recirculation loop. Check all pressure gauges to verify that nozzles are not plugged.

4. PLC and CEM Systems. Check to insure that there is adequate calibration gas available for the next week. Clean all traps and filters in the gas cleanup system for the CEM. Verify that all CEM probes in the system are clean and functioning properly.

TABLE XV.B WEEKLY CEMENT-LOCK SYSTEM INSPECTION				
ITEMS TO BE INSPECTED	**RESULTS**		**CORRECTIVE ACTION**	
	PRESENT	**NOT PRESENT**	**NEEDED**	**DATE ACCOMP.**
Kiln, Afterburner, & Melt Burners				
High Temperature Cutoff		±		
Low Temperature Cutoff		±		
Flame Loss Cutoff		±		
CEM				
Any Instrument Failure Cutoff		±		
High CO Cutoff		±		
Low O_2 Cutoff		±		
CO Calibration		±		
O_2 Calibration		±		
Sample Line Heat		±		
Probe Integrity		±		
pH Electrode Calibration		±		
Natural Gas				
Inadequate Natural Gas Cutoff		±		
Combustion Air				
Safe Burner Interlocks		±		

Signature of Inspector: _____ Date:

Note: All checks within circles must be addressed under "Corrective Actions".

C. Monthly Maintenance

1. Calibrate all instruments in all component parts of the system, including thermocouples.

2. Do a detailed examination of all external surfaces of refractory lined equipment for signs of refractory failure and then do a detailed visual inspection through the sight ports of the refractory condition throughout the system. If refractory damage has occurred to the point that repairs are necessary, the system will have to be shut down for refractory repairs.

3. Check all metal components of the system for signs of corrosive damage. If corrosion is beginning to occur, clean and repaint the corroded areas. If temperature damage is noted, schedule a replacement of the temperature damaged area and repair the cause of the temperature damage.

4. Verify structural integrity of all supports, platforms, hand rails, toe plates, and guards and be sure that all fasteners are tight.

5. Verify that all limit switches on all equipment items are functioning properly and are properly adjusted.

6. The drive chains for the following equipment should be oiled on a monthly basis.

    Alternate Feed Bin Agitator (T-102)
    Granulator (C-203)
    Wet Ecomelt Rotary Feeder (F-205)
    Dried Ecomelt Rotary Feeder (F-206)
    Dryer Cyclone Dust Discharge Rotary Feeder (F-401)
    Bag Filter Dust Discharge Rotary Feeder (F-402)
    Baghouse Dust Discharge Rotary Feeder (F-303)
    Lime Feeder Air Lock (F-302A)
    Ecomelt Hopper Rotary Feeder (F-219)

D. Annual Maintenance (Requires Shutdown)

1. Kiln, Afterburner and Dryer. Open all access doors and provide ventilation to completely purge the system with ambient air. Enter the inspection doors and inspect all internal surfaces of the entire system. Check for refractory damage and repair any refractory damage. Check all expansion joints and repair the expansion joints if they have been damaged. Check that the stack cap bearings are properly lubricated and that the stack cap is operating properly. It will be necessary to measure the force required to open the stack cap and to adjust the quantity of ethylene glycol-water in the trim tank to insure that the cap opens at the proper positive pressure. Also verify that the refractory lining in the stack cap is completely

intact. Remove the cover plates from the rotary valve below the baghouse and clean the valve. If abnormal wear has occurred on the valve plates or seals, replace them. Open up the granulator and check for solids buildup, wear on any of the guide mechanism, chain wear, flight wear, bottom wear, or sprocket wear. Replace any worn components. Clean all fuel supplied trains to the burners, clean the burner nozzle tips, and clean the burner refractory tiles. If necessary, replace any heat-damaged components on the burners.

2. Air Pollution System. Inspect the refractory in the quench inlet and repair if necessary. Remove each spray nozzle in the system and check for wear and/or pluggage. Replace the nozzles if necessary. Open all access doors on the entire system. Check the quencher water tank for sediment. Clean the tank if sediment is found. If any of the recirculation pumps have indicated either low flow or low pressure during recent operation, remove the pump impellers and check for wear. If wear is found, replace the pump impeller. Fan and blower access doors should be opened and then pressure washed to clean both the wheel and the housing.

3. After the annual inspection has been completed, close up and reseal all doors, clean and paint any area which needs touchup paint, replace any gaskets and seals which require replacement, and the system is then ready for restart.

TABLE XV.C MONTHLY CEMENT-LOCK SYSTEM INSPECTION				
ITEMS TO BE INSPECTED	**RESULTS**		**CORRECTIVE ACTION**	
	PRESENT	**NOT PRESENT**	**NEEDED**	**DATE ACCOMP.**
Compressed Air				
Dryer Not Plugged		±		
Moisture Traps Operable		±		
Air is Dry		±		
Crankcase Vent Clean		±		
Inlet Filter Clean		±		
Corrosion				
Vessel Surfaces – Corrosion Present	±			
Structural Steel Corrosion Present	±			
Rotary Kiln Melter				
Hot Spots on Vessel	±			
View Port At Afterburner – Refractory OK		±		
View Port At Kiln-Refractory OK		±		
View Ports At Melt Section – Refractory OK		±		

Signature of Inspector: _____ Date:

Note: All checks within circles must be addressed under "Corrective Actions".

TABLE XV.D QUARTERLY CEMENT-LOCK SYSTEM INSPECTION				
ITEMS TO BE INSPECTED	**RESULTS**		**CORRECTIVE ACTION**	
	PRESENT	**NOT PRESENT**	**NEEDED**	**DATE ACCOMP.**
Rotary Kiln Melter				
Hazardous Melt Accum.-Primary	±			
Hazardous Melt Accum.-Secondary	±			
Refractory Damage-Primary	±			
Refractory Damage-Secondary	±			
Burner Tile Damage	±			
Refractory Damage-Stack	±			
Fans & Blowers				
Housing Cracks	±			
Fan Wheel Cracks	±			
Seal Leaks	±			
Imbalance	±			
Bearing Noise	±			
Wheel Interference With Housing	±			
Leaking Gaskets or Seals	±			
Pumps				
Centrifugal Pump Impeller Damage	±			
Reassembly				

TABLE XV.D QUARTERLY CEMENT-LOCK SYSTEM INSPECTION				
ITEMS TO BE INSPECTED	**RESULTS**		**CORRECTIVE ACTION**	
	PRESENT	**NOT PRESENT**	**NEEDED**	**DATE ACCOMP.**
Access Door Leaks	±			
Flange Connection Leaks	±			
Gasket & Seal Leaks	±			

Signature of Inspector: _____ Date:

Note: All checks within circles must be addressed under "Corrective Actions".

XVI. TROUBLE SHOOTING

GENERAL TROUBLE SHOOTING

PROBLEM	PROBABLE CAUSE	POSSIBLE REMEDY
A motor will not remain running	Motor in front of down motor that is not running properly	Check other motors in interlocked sequence
	Bad interlock	Replace
	Motor pulling too much amperage	Check for obstruction and/or Contact Andersen 2000 Field Service Department
Loud or unusual noises	Vibrations	Check for proper support and balancing of moving equipment
	Binding of moving parts	Re-align coupling of moving parts
	Squealing of belt drives	Tighten belts
Corrosion	Sulfur or chlorine in feedstock	Check chemistry of material (eliminate or blend materials to reduce concentrations)
	Failure of paint or surface coating	Blast surfaces and re-coat with proper coating
	Dew point excursions	Change control system set-points to minimize temperature swings
	Improper start-up and shutdown	Follow proper heat-up and cool-down procedures (do not process material when baghouse exit temperature is below 250°F)

FEED SYSTEM TROUBLE SHOOTING

PROBLEM	PROBABLE CAUSE	POSSIBLE REMEDY
Inconsistent feed rate	Inconsistent flow out of bin auger feeder	Check for and remove material build-up on belt scale idlers
	Belt scale interference	Contact Andersen 2000 Field Service Department for other causes
	Material clogging on scalping screen	Improve preparation of feedstock
Material spillage under hopper or at transfer points	Gaps in flashing	Adjust or replace flashing
Bridging of material in feed bin	Material piled too high in bin	Reduce amount of material placed in bin (load hopper more often)
	Material is particularly sticky	Improve material preparation

FEED SYSTEM TROUBLE SHOOTING, CONTINUED:

PROBLEM	PROBABLE CAUSE	POSSIBLE REMEDY
Plugging of PTU feed chute	Material hits intermediate surface of divert chute or PTU inlet chute	Re-align divert chute when in feed position to improve path of material

CONVEYOR TROUBLE SHOOTING

PROBLEM	PROBABLE CAUSE	POSSIBLE REMEDY
Belt running to one side of conveyor at a particular point.	Rollers just preceding the trouble spot not square with belt	Advance the end of idlers to which belt is running in same direction as belt travel
	Conveyor frame bent or sagging	Straighten or shim supports
	Sticking idlers	Free idler rotation
	Material build-up on idlers	Clean idlers with compressed air
	Conveyor not level	Level and shim conveyor frame
Belt follows no particular pattern	Belting has become too stiff	Replace with more pliable belt
	Any combination of alignment problems above	Locate and correct
Severe wear on pulley side of belt	Drive pulley slippage	Tighten belt using tail pulley adjustment
	Material ground between belt and pulley	Improve material loading to avoid spillage
	Sticking idlers	Free idler rotation
	Protruding bolt heads	Tighten bolts
	Excessive tilt in troughing idlers	Adjust 2°
Excess belt tension	Tension too high	Decrease tension using tail pulley adjustment

CONVEYOR TROUBLE SHOOTING, CONTINUED:

PROBLEM	PROBABLE CAUSE	POSSIBLE REMEDY
Breaks parallel to belt edges	Impact of lumps falling on belt	Reduce impact at transfer points
Fasteners pulling out	Wrong type of fasteners	Replace with correct fasteners
	Fasteners loose	Tighten
	Tension too high	Reduce tension using tail pulley adjustment
Lengthwise belt rupture with cover unbroken	Joining of many breaks due to material impact	Reduce impact at transfer points
Cover blisters	Sand working under cover through cuts	Spot repair with vulcanizer
Severe wearing in area contacted by skirting	Skirting cut uneven	Re-cut or replace skirting
	Excessive belt sag at loading point. Material lodges between belt & skirting	Increase take up tension in belt or reduce idler spacing at loading point
Excessive top wear (uniform across belt)	Dirty, stuck or mis-aligned return idlers	Clean, free or align
Belt will not remain tight (stretching problem)	Belt has become saturated with oil from contaminated soils	Replace belting (with oil-resistant belting)
Material build-up on idlers	Belt scraper not effective	Adjust scraper wiper blade so that it fits against belt
	Belt wiper blade worn out	Replace wiper blade

ECOMELT GENERATOR TROUBLE SHOOTING

PROBLEM	PROBABLE CAUSE	POSSIBLE REMEDY
Drum crowding	Trunnion misalignment	Align trunnions
Uneven wear on one side of drum tire and/or on the thrust roller	Trunnion misalignment	Align trunnions
Fuel usage higher than normal	Higher than normal soil moisture content	Check soil moisture content. Manage feedstock stockpiles to use driest material first
	Poor air to fuel ratio	Adjust burner
	Abnormal inlet leakage	Check inlet and outlet seals for wear or damage.
	High burner suction draft resulting in high excess air	Reduce burner suction setpoint
Fuel leaks detected around burner components	Fuel leak at fittings, valves or other burner fuel connections	Tighten fittings, replace fittings or valves, replace worn or damaged hose, piping, gauges, etc.
Problem in shutting-off burner fuel (fuel leaks into burner when off)	Dirt in safety valve	Install a fuel strainer prior to safety valve
	Defective safety valve(s)	Replace valve(s)
	Wear due to foreign material in fuel piping (rust or sand and gravel from installation)	Replace worn components and/or clean lines of foreign material
	Normal parts wear	Replace worn components
	Abrasive ingredient in fuel	Discuss with fuel supplier

ECOMELT GENERATOR TROUBLE SHOOTING, CONTINUED:

PROBLEM	PROBABLE CAUSE	POSSIBLE REMEDY
High or low burner suction	Improper control setting	Reduce or increase set-point and/or dampening/ proportional band of I.D. fan damper controller
	Clogged sensor line in burner suction monitor	Blow-out line to remove moisture or dust accumulation
Low production with high amp draw on burner blower	Burner blower turning backwards	Change rotation of blower
Unable to achieve main flame	Flame scanner not positioned properly	Re-position scanner
	Flame scanner inoperable	Replace scanner
	Ignition rod not sparking	Adjust or replace ignitor
Puffing back at PTU seals	Oxidation of contaminant in PTU	Review contaminant type and clean-up levels. Reduce PTU temperature if possible
	Insufficient draft	Increase draft control set-point
	Insufficient draft due to low I.D. fan speed	Check shaft speed, confer with Andersen 2000 Field Service Department and possibly increase speed of fan
	High pressure drop across bag house causing low burner suction	(see baghouse section)

ECOMELT GENERATOR TROUBLE SHOOTING, CONTINUED:

PROBLEM	PROBABLE CAUSE	POSSIBLE REMEDY
Material spillage at PTU feed end seal	PTU rotational speed too slow, preventing material from moving away from feed inlet point	Speed up rotation of PTU
	Spiral flights damaged or ineffective	Repair or modify flights
Clean-up levels not achieved for processed materials	Processing temperature too low	Raise operating temperature
	Inadequate retention time	Reduce processing rate, slow rotational speed of PTU, or add dams to increase retention time of material
	PTU drum speed too fast	Slow down rotational speed of PTU

MATERIAL DISCHARGE SYSTEM TROUBLE SHOOTING

PROBLEM	PROBABLE CAUSE	POSSIBLE REMEDY
Pugmill gets jammed	Oversized material being introduced into system	Jog pugmill in reverse, review feedstock material and pre-screen
	Not enough clearance between tips and trough	Adjust shanks and/or tips

SECONDARY COMBUSTION CHAMBER TROUBLE SHOOTING

PROBLEM	PROBABLE CAUSE	POSSIBLE REMEDY
Unable to achieve temperature	Production rate too high	Lower production rate
	Excess air too high	Adjust air/fuel ratio to decrease excess air level
	Limited fuel flow to burner	Increase burner fuel pressure
Fuel usage higher than normal	Higher than normal soil moisture content	Check soil moisture content. Manage feedstock stockpiles to use driest material first
	Poor air to fuel ratio	Adjust burner
	Abnormal inlet leakage	Check access doors and duct connections for proper seal
	High burner suction draft resulting in high excess air	Reduce burner suction setpoint
	Low Btu content in fuel	Use higher quality fuel
Fuel leaks detected around burner components	Fuel leak at fittings, valves or other burner fuel connections	Tighten fittings, replace fittings or valves, replace worn or damaged hose, piping, gauges, etc.
Problem in shutting-off burner fuel (fuel leaks into burner when off)	Dirt in safety valve	Install a fuel strainer prior to safety valve
	Defective safety valve(s)	Replace valve(s)
	Wear due to foreign material in fuel piping (rust or sand and gravel from installation)	Replace worn components and/or clean lines of foreign material
	Normal parts wear	Replace worn components
	Abrasive ingredient in fuel	Discuss with fuel supplier

SECONDARY COMBUSTION CHAMBER TROUBLE SHOOTING, CONTINUED

PROBLEM	PROBABLE CAUSE	POSSIBLE REMEDY
Low production capacity with high amp draw on burner blower	Burner blower turning backwards	Change rotation of blower
Slag build-up around burner (inside STU chamber)	Feedstock has low melting point	Review chemistry of soils, blend with other materials if possible
	High STU burner chamber temperature	Increase STU excess air to lower flame temperature
Unable to achieve main flame	Flame scanner not positioned properly	Re-position scanner
	Flame scanner inoperable	Replace scanner
	Ignition rod not sparking	Adjust or replace ignited

FLUE GAS QUENCHER TROUBLE SHOOTING

PROBLEM	PROBABLE CAUSE	POSSIBLE REMEDY
High quencher exit temperature (or high baghouse inlet temperature)	Flue gas quencher temperature control not operating properly	Temperature control in manual and operator not aware
		Temperature controls not working properly, check and repair or replace
	Fluctuating water pressure	Stabilize pressure of water supply
	Water modulation valve or actuator damaged	Replace valve/actuator
	Flue gas quencher not evaporating water properly	Check water injection manifold water pressure, increase if necessary and check for leaks
		Check water injection manifold air pressure, increase if necessary and check for air leaks
		Remove a water injection lance to visually check for atomized water delivery and correct connections of water and air lines
	Not enough water available	Increase water pressure
		Clear obstruction in water supply
	Production rate too high	Decrease production rate

FLUE GAS QUENCHER TROUBLE SHOOTING, CONTINUED:

PROBLEM	PROBABLE CAUSE	POSSIBLE REMEDY
Excess material (mud) build-up in exit of chamber	Water nozzles not atomizing water	Check nozzle for wear or mineral deposits, replace if necessary
	Cooling water not being atomized properly	Check delivery pressure and flow rate of atomizing air, remove any obstructions from air line, increase air pressure
Water accumulating and running out of lower end of chamber	Water not shutting off properly	Control in manual and operator not aware Water valve/actuator replacement
Restricted air or water flow due to deposits from hard water	Hard water (calcium/magnesium concentration greater than about 200 ppm)	Clean water deposits from nozzles, check water hardness, install water softeners

NOTE: Any small problem can turn into a major failure if not corrected promptly.

BAGHOUSE TROUBLE SHOOTING

PROBLEM	PROBABLE CAUSE	POSSIBLE REMEDY
High baghouse inlet temperature	Flue gas quencher not working properly	(see flue gas quencher trouble shooting section)
High pressure drop across baghouse	*Blinded bags (high pressure drops reduce air flow capacity to system)	Bags blinded by moisture or hydrocarbons. Possibly can be laundered. May need bag replacement.
	Dirty bags	Check time delays for proper cleaning sequence, pulse frequency and pressure
		Check solenoid operation
	Malfunction of bag cleaning system	Check all cleaning system components
	Ineffective cleaning	Modify cleaning cycle
	Re-entrainment of dust in collector due to low density material or in-leakage at discharge	Check discharge valves for leak
		Reduce total air flow to lower air-to-cloth ratio
	Wetting of bags	Dry bags with clean air
		Control dew point excursions
		Clean bags or replace

***NOTE:** Items that may cause bag blinding are: improper fuel/air ratio in STU, low temperatures in baghouse with excessive moisture, and possible too low afterburner temperature.

BAGHOUSE TROUBLE SHOOTING, CONTINUED:

PROBLEM	PROBABLE CAUSE	POSSIBLE REMEDY
Abnormally low pressure drop	Line(s) plugged	Blow back through lines Protect sensing point from dust or water buildup Incorporate auto-purging system in sensing lines Air purge lines periodically to remove trapped moisture
	Manometer line(s) broken or uncoupled	Inspect and repair
	Over cleaning of bags	Reduce cleaning energy and cycle time
*Low temperature in baghouse	Low exit temperature of Flue Gas Quencher	Adjust Flue Gas Quencher temperature control to raise temp. of baghouse inlet
	Air infiltration in ductwork or baghouse	Inspect for leaks in duct connections and/or baghouse access doors
*High moisture in baghouse	Low exit temperature of Flue Gas Quencher	Adjust Flue Gas Quencher temperature control to raise temp. of baghouse inlet
Low production with low or high amp draw on fan	Damper stuck or inoperable	Repair damper
	Damper actuator failure	Repair or replace actuator

***NOTE:** High moisture and lower temperatures in baghouse will cause blinded bags, acid attack on the bags, caking of the fines in the house and other problems. The temperatures in the baghouse should be 350°F minimum and 400°F maximum.

BAGHOUSE TROUBLE SHOOTING, CONTINUED:

PROBLEM	PROBABLE CAUSE	POSSIBLE REMEDY
Low dust discharge rate from baghouse	In-leakage at discharge points	Inspect and repair seals or rotary valves
	Malfunction of discharge valve and/or screw conveyor	Inspect and repair
	Re-entrainment of dust in collector	Check for leaks at discharge or hopper
	Retainment of dust on filter bags	Increase cleaning frequency, increase cleaning pressure
Dust augers binding	Worn bushings allow auger to contact trough causing binding	Replace auger bushings

DAMAGE TO BAGHOUSE

Several conditions that will cause damage to the baghouse are: high moisture, low temperature, rich fuel/air ratio and hydrocarbons. A high SO_2 content, even at temperatures above the dew point, can cause damage to the bags and baghouse.

STACK GAS DISCHARGE TROUBLE SHOOTING

PROBLEM	PROBABLE CAUSE	POSSIBLE REMEDY
Visible smoke (blue or black), high CO or high combustibles	Fuel-to-air ratio too rich, or not enough oxygen in STU	Check contaminant level in feedstock for excessive concentrations Increase STU combustion air setting so that fuel to air ratio maintains enough oxygen for contaminant and fuel oxidation Increase position of PTU tempering air damper.
	Heavy contaminant being treated, requiring higher temperatures	Increase temp. in STU so that vaporized hydrocarbons will oxidize
High oxygen content at stack (inefficient overall process)	Fuel-to-air ratio too lean or too much oxygen in STU	Decrease STU combustion air setting so that fuel to air ratio is increased
	Fuel-to-air ratio too lean or too much oxygen in PTU	Decrease PTU combustion air setting so that fuel to air ratio is increased

STACK GAS DISCHARGE TROUBLE SHOOTING, CONTINUED:

PROBLEM	PROBABLE CAUSE	POSSIBLE REMEDY
Stack Particulate Emission (from baghouse leaks)	Bag shrinkage causing broken or torn bag(s)	Inspect, locate and replace damaged bags Use Visolite kit
	Bags not seated properly	Test to determine which bags are not seated properly and correct Use Visolite kit
	Leakage from clean to dirty zones of baghouse	Inspect sidewalls and tubesheet for leaks, repair any leaks
Stack Particulate Emission (from particle penetration through bags)	Over cleaning bags (not enough material cake on bags)	Check cleaning system pressure and duration. Reduce pressure if possible
	Bag permeability increase	Test bag Check cleaning pressure and duration. Reduce pressure if possible
	Too high air-to-cloth ratio	Verify gas volume and make any possible changes to reduce volume (i.e. lower production rates and/or excess air)
	Change of inlet conditions	Inspect and review
	Inadequate particle size distribution in dust cake	Use pre-coating material on bags

STACK GAS DISCHARGE TROUBLE SHOOTING, CONTINUED:

PROBLEM	PROBABLE CAUSE	POSSIBLE REMEDY
Visible Emission (white)	Salt plume resulting from salt contacting high temp. gases	Check feedstock for brine content Check cooling water salinity level

NOTE: Any small problem can turn into a major failure if not corrected promptly. Contact the various Andersen 2000 Field departments for help, advice or assistance.

CROWN ANDERSEN INC

Cement-Lock® Technology
Classroom Training Session

3 September 2003

ANDERSEN 2000 INC
Peachtree City, GA USA

Training Program Review

- *Classroom Style Format*
- *Program is designed to provide an overview of the process technology and major system components*
- *Establish basic familiarity with the system to facilitate hands-on training program*
- *Review basic safety issues*
- *Discuss start-up and shut down procedures*
- *Review maintenance and troubleshooting procedures*

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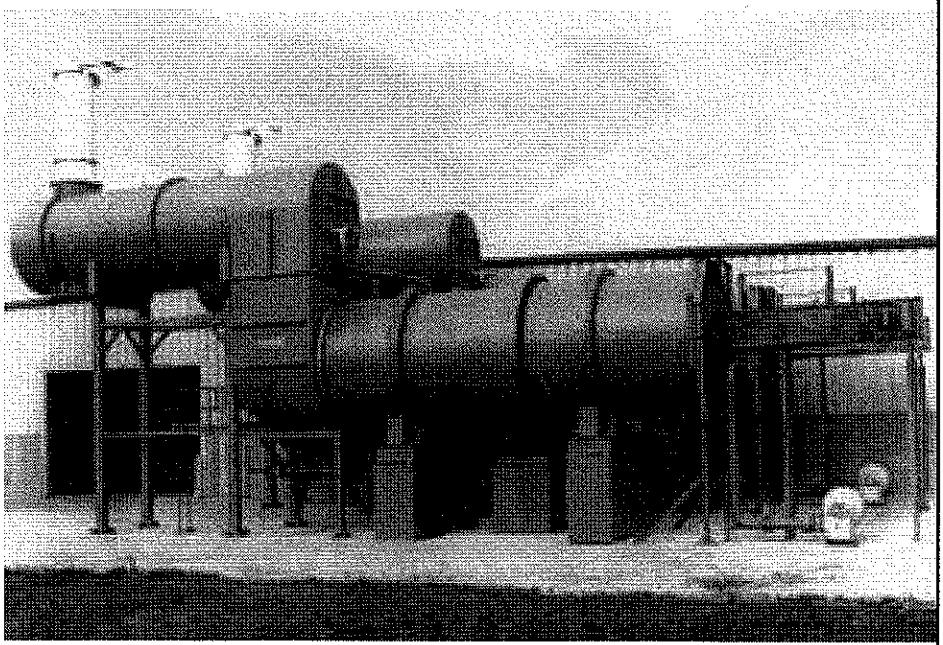
Ecomelt Process Review/Description



General Safety Precautions

- ***Always operate the equipment within the design specifications for the system***
- ***Establish an enforce a written safety program for the facility***
- ***Follow the safety precautions specified by Andersen 2000***

General Safety Precautions

- ***Read and understand each of the cautions, warnings, and instructions in the operator's manual and on signs fixed to the equipment.***
- ***Inspect all equipment components before each operating shift to ensure that no parts are damaged or suspected of being damaged. Repair or replace damaged parts before starting or operating the equipment.***
- ***Check for warning tags and locks on equipment components or controls before starting or operating the equipment.***

General Safety Precautions

- ***Do not allow unskilled persons to start or operate any equipment without the proper supervision of a skilled operator.***
- ***Never leave equipment controls unattended. Always have a qualified operator relieve you if you must leave.***
- ***When starting equipment, follow the manufacturers recommended starting sequence.***

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General Safety Precautions

- ***During startup and while the equipment is operating, be alert for improper readings, visual defects, odors or unusual sounds that could be a warning of a potential hazard. Shut down equipment immediately, following established shutdown procedures, if any unsafe condition should arise.***

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General Safety Precautions

- *Do not work on equipment while it is in operation. Shut down, lockout, and tag all machine controls before performing any inspection, maintenance, lubrication or adjustment. Perform all required inspection, maintenance, lubrication or adjustments before starting or operating the equipment, or after the equipment is shut down.*

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General Safety Precautions

- *Perform all inspection, maintenance, lubrication, and adjustment procedures with caution and in accordance with the manufacturer's recommended procedure.*
- *Ensure that all guards and safety devices are properly installed and in working order before starting or operating the equipment.*
- *Do not allow unauthorized personnel in or around the work area and equipment. Know who is in your work area at all times. Use a head count when necessary.*

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General Safety Precautions

- *Refractory that has not been cured can release moisture explosively in the form of steam and debris from broken refractory if exposed to excess temperature or to rapid heat-up. If the system has any uncured refractory, it is necessary to cure it in exact accordance with instructions in this manual before starting up this system. Failure to do so will result in serious equipment damage and possible injury to operating personnel.*

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General Safety Precautions

- *Fuel can leak past damaged valves or burners in any incinerator system. Fumes from such leaking fuel can accumulate inside the rotary kiln melter and ignite explosively during system start-up. The burner safety systems are designed to prevent any such occurrence, but if any safeties have been bypassed, damaged or defeated, an extremely unsafe and explosive condition could develop rapidly.*

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General Safety Precautions

- ***Do not operate any portion of this system if any safeties have been damaged, defeated or altered in any way and do not operate this system if you have not been properly trained.***

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General Safety Precautions

- ***Do NOT depend on computerized controls to protect you from malfunctions.***

Specific Safety Precautions

- *Never open any access door on the system while the incinerator is in operation.*
- *Stay clear of conveyors as they may start automatically. If necessary to repair or adjust any of the equipment, place the power switch in the off position and lock and tag the power disconnect switch.*
- *Do not rely on the hydraulic system to hold charge doors in the open position during inspection or maintenance. Securely block the doors open so they cannot close.*

Specific Safety Precautions

- *Keep clear of all moving equipment and pinch points. Do not wear loose fitting clothing that can become caught in moving parts.*
- *Never enter the chambers of mechanical loaders, waste feed systems, ash conveyors, the incinerator or other equipment without first taking the normally recognized safety precautions of de-energizing and locking out all power sources. Also, all fuel supplies should be locked out as well.*

Specific Safety Precautions

- ***Do not enter any vessel unless all access doors are open and a positive ventilation system has been installed. Check for appropriate oxygen levels within the equipment and do not enter any vessel without checking for combustible or toxic gases. Work of this type should never be done alone, but always in the presence of a second individual who is familiar with the equipment control circuits involved and who is also able to implement safety procedures, including rescue from the vessel, if required.***

Specific Safety Precautions

- ***Make sure all safety systems are operable (flame detectors, water sprays, emergency lockout devices and emergency stop switches) which have been provided as a part of the equipment system.***

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Hardware Inspections

- *A thorough inspection of the equipment should be conducted before the equipment is started.*
- *Primary Combustion Chamber (Ecomelt Generator R-201) and Secondary Combustion Chamber (Afterburner R-202).*
  - *Never bypass safety/burner interlocks*
  - *Inspect all refractory*
  - *Close and secure all access doors*
  - *Open main fuel shut off valves*

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Hardware Inspections

- *Air Pollution Control Equipment*
  - *Check quench water pumps*
  - *Temperature switches for bleed air to baghouse*

Utilities Availability

- *Fail Safe System*
  - *Natural Gas*
  - *Electrical Power*
  - *Instrument Air*
  - *Process Water*
- *Do not disable or bypass safeties*

Controls and Alarms

- *Do not disable or bypass alarms*
- *Test all alarm functions on a weekly basis*
- *Do not modify or change program logic without approval from Andersen*

Burner Safeties

- *Basic Burner Safeties*
  - *Low fuel pressure switch*
  - *Fan proving switch/combustion air pressure switch*
  - *Flame detector*
- *Never operate burners without an operable flame detector*
- *Never manually light the burners-always use automatic prepurge ignition sequence*
- *Become thoroughly familiar with the burner manual information*

Solids Conveying Systems

- *Make sure system is lubricated and maintained in accordance with the manufacturer's recommendations*
- *Never attempt to adjust, service or repair the conveying systems while the equipment is in operation*

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Process Overview

- *Sediment Processing System*
  - *Primary Treatment System(Ecomelt Generator)*
  - *Secondary Treatment System*

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Process Overview

- *Primary Treatment System*
  - *Material Feed System*
  - *Primary Treatment Unit (PTU)*
  - *Ecomelt Quench System*
- *Secondary Treatment System*
  - *Quench Chamber*
  - *Lime Injection/Fabric Filter Baghouse*
  - *Activated Carbon Adsorption System*
  - *Induced Draft Fan*

Process Overview

- *Ecomelt Handling System*
  - *Dryer System*
  - *Screw Conveying System*
  - *Bucket Elevator*
  - *Ecomelt Storage silo*

Process Overview

- *Safety Equipment*
  - *High Temperature Automatic Shutdown*
  - *Fully Modulating Burner Systems*
  - *UV Flame Detection System*
  - *Conveyor Local Stop Cables*
  - *OSHA Related Equipment (Toeplates/Caged Access Ladders)*

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Major System Component Review

- *Sediment Storage Bin (T-101)*
  - *Live Bottom Configuration*
  - *2,450 ft^3 Capacity*
- *Alternate Feed Bin (T-102)*
  - *660 ft^3 Capacity*
  - *Live Bottom/Dual Screw Configuration*
  - *304 Stainless Steel Construction*

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Major System Component Review

- *Transfer Conveyor (C-102)*
  - *15° inclined, totally enclosed screw conveyor*
  - *Capable of delivering 104 ft^3 of 76 lb/ ft^3 density alternative feed material*
  - *Moves material to transfer conveyor C-101*
- *Transfer Conveyor (C-101)*
  - *15° inclined, totally enclosed screw conveyor*
  - *Capable of delivering 108 ft^3 of 76 lb/ ft^3 density harbor sediment to weigh screw conveyor (C-112)*

Major System Component Review

- *Weigh Screw Conveyor (C-112)*
  - *Totally enclosed 12" diameter screw conveyor*
  - *Capable of delivering 108 ft^3 of 76 lb/ ft^3 density material to the sediment/modifier mixer (M-131)*

Major System Component Review

- *Modifier #1 Storage Hopper (T-103)*
  - *2,500 ft^3 storage capacity for modifier*
  - *10' OD and 36' overall height*
  - *0.25" carbon steel construction*
  - *Equipped with Griffin bin vent filter*
  - *5' OD live bottom bin activator*
  - *Feeds into vibratory feeder (F-103)*

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Major System Component Review

- *Screw Conveyor (C-103)*
  - *Totally enclosed, 6" screw conveyor*
  - *Capable of delivering 14 ft^3 of modifier #1 (90 lb/ ft^3) to the sediment modifier mixer (M-131)*

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Major System Component Review

- *Modifier #2 Storage Hopper (T-104)*
  - *130 ft^3 storage capacity for modifier*
  - *5' OD and 9' overall height*
  - *3/16" carbon steel construction*
  - *3' OD live bottom bin activator*
  - *Feeds into belt feeder (F-104)*

Major System Component Review

- *Bucket Elevator (C-104)*
  - *Provided for top loading of Ecomelt Storage Silo*
  - *Capable of transferring 94 ft^3/hr of ecomelt material*
  - *Carbon steel construction*
  - *1 HP drive motor*

Major System Component Review

- *Sediment/Modifier Mixer (M-131)*
  - *FEECO Model 2208 paddle style mixer*
  - *23" wide x 8' long trough complete with drive package, reducer and motor*
  - *Carbon steel construction*

Major System Component Review

- *Water Cooled Feed Auger/Screw Feeder (C-151)*
  - *12" water cooled screw*
  - *Capacity of 117 ft^3 of 78 lb/ft^3*
  - *Carbon steel construction*
  - *Bottom discharge for off-spec material*

Major System Component Review

- *Ecomelt Generator (R-120)*
  - *8' 7.75" ID x 30' long*
  - *9.5" two component, refractory lining*
  - *0.75" carbon steel shell*
  - *Bottom discharge for off-spec material*
  - *30 mm Btu/hr maximum heat release*
  - *40 HP drive motor*

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Major System Component Review

- *Ecomelt Generator (R-120)*
  - *Designed to process 3,431 lb/hr of combined sediment and modifier mixture*

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Major System Component Review

- *Secondary Combustion Chamber (R-202)*
  - *7' 2.25" ID*
  - *0.25" Carbon Steel Construction*
  - *Two component, refractory lining*
  - *1.8 second residence time at maximum gas flow and temperature conditions*

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Major System Component Review

- *Burner System (HX-101/102)*
  - *30.0 mm Btu/hr North American gas fired burner in Ecomelt Generator*
  - *5.0 mm Btu/hr North American gas fired burner in secondary Chamber/Afterbuner*

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Major System Component Review

- *Ecomelt Discharge system (HX-203 & Z-203)*
  - *Ecomelt product is conveyed to the end of the generator where it discharges into refractory lined chamber*
  - *Ecomelt product is contacted with water in this area*
  - *Discharge chamber includes three, 500,000 Btu/hr gas fired burners to maintain the flow of Ecomelt until it reaches the water cooling zone*

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Major System Component Review

- *Granulator with Recirc. Tank/Pump (C-203)*
  - *Granulator is a wet-type, drag style conveyor w/2.0 HP drive motor*
  - *Liquid level is maintained by a float in the recirculation tank*
  - *Liquid from conveyor overflows into this tank*
  - *150 gpm, 40 psig, cast iron pump with 7.5 HP, 1750 RPM driver is provided for circulation the cooling water for the conveyor and Ecomelt discharge section*

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Major System Component Review

- *Wet Ecomelt Conveyor/Rotary Feeder (C-205)*
  - *20° inclined, totally enclosed, 12" screw conveyor*
  - *Capacity to deliver 300 ft^3/hr of granulated Ecomelt product with a density of 56 lb/ft^3*
  - *Carbon steel construction*
  - *Discharges into a 12" x 12" rotary airlock at inlet of Ecomelt dryer*

Major System Component Review

- *Quencher and Double Tipping Valve (Z-103)*
  - *2550° f flue gas from the afterburner discharges into the evaporative cooler/quench system*
  - *Discharge temperature is approximately 350° f*
  - *Upper portion is carbon steel construction with refractory lining*
  - *Lower portion of evaporative cooler is 1/4", 316L stainless steel construction*
  - *Base includes double tipping valve for discharge of solid material*

Major System Component Review

- *Quench Water Pump (P-301)*
  - *Supplies water to evaporative cooler, auger/feeder and make up water to granulator recirculation tank*
  - *Pump is 80 gpm, 100 psig with 15 HP, 1750 RPM driver*

Major System Component Review

- *Quench Water Tank (T-301)*
  - *11,000 gallon XLHDPE tank with heat tracing and insulation*

Major System Component Review

- *Stack Cap (S-202)*
  - *Counter weighted, pneumatically actuated emergency vent for the system*
  - *Includes 3 gallon stationary air tank for compressed air*

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Major System Component Review

- *Lime Feed System (T-302)*
  - *500 ft^3 storage capacity for hydrated lime*
  - *75" OD, 20' overall height*
  - *Carbon steel construction*
  - *Griffin bin vent filter*
  - *3' OD live bottom bin activator*
  - *Vibratory feeder system*
  - *6" x 6" rotary airlock*

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Major System Component Review

- *Lime Eductor Blower (B-302)*
  - *Takes a slipstream of air from quencher discharge and utilizes it to inject lime into the baghouse*
  - *Arrangement 9, centrifugal fan rated for 416 ACFM at 8" W.G. static pressure*
  - *Fan includes 2 HP drive motor*

Major System Component Review

- *Baghouse (S-303)*
  - *Carbon steel construction*
  - *4,973 ft^2 of bag surface area*
  - *324 bags, 6" OD x 10' long*
  - *4.26:1 air to cloth ratio*
  - *8" x 8" rotary airlock for solids discharge*

Major System Component Review

- *Activated Carbon Bed (A-304)*
  - *Constructed of 1/4" carbon steel*
  - *Two separate carbon beds*
  - *Fire protection system*

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Major System Component Review

- *Air Compressor (P-305)*
  - *Gardner Denver, 100 HP, screw type compressor*
  - *System delivers 320 scfm of 125 psig compressed air*
  - *Includes dryer for instrument air*
  - *System includes 350 gallon receiver tank*

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Major System Component Review

- *Induced Draft Fan (B-304)*
  - *Designed for a gas flow of 24,220 ACFM and 14.35" W.G. static pressure*
  - *Carbon steel construction*
  - *100 HP , 1775 PRM drive motor*
  - *Arrangement #9 configuration driven at 1250 RPM*

Major System Component Review

- *Exhaust Stack (S-304)*
  - *1/4", Carbon steel construction*
  - *30" ID, 50' tall*
  - *Includes sampling ports*

Major System Component Review

- *Ecomelt Dryer (D-206)*
  - *3' ID x 30' long carbon steel dryer*
  - *5 HP drive motor*
  - *Includes refractory lined combustion chamber w/1.0 mm Btu/hr, gas fired burner*
  - *12" x 12" rotary airlock for discharge of Ecomelt product*

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Major System Component Review

- *Dried Ecomelt Conveyor (C-216)*
  - *5° inclined, totally enclosed screw conveyor*
  - *Capacity to deliver 120 ft^3/hr of dry, Ecomelt material with a density of 40 lb/ft^3*
  - *Capable of handling 250° f material*

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Major System Component Review

- *Dried Ecomelt Bucket Conveyor (C-217)*
  - *Capacity of 800 ft^3/hr*
  - *Carbon steel construction*
  - *3 HP drive motor*

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Major System Component Review

- *Eomelt Storage Hopper (T-219)*
  - *Capacity of 6,750 ft^3 of dried Ecmelt material*
  - *1/4", carbon steel construction*
  - *14' OD, 57' overall height*
  - *7' OD live bottom bin activator*
  - *12" x 12" rotary air lock for discharge of material*

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Major System Component Review

- *Ecomelt Product Conveyor (C-219)*
  - *20° inclined, totally enclosed, 12", screw conveyor*
  - *Capacity to deliver 300 ft^3/hr of 40 lb/ ft^3 density material*
  - *Transfers material to a transportable container*

Major System Component Review

- *Ecomelt Dryer Cyclone System (M-401)*
  - *Designed for 550 ACFM of 250° f flue gas discharging from the Ecomelt dryer*
  - *Includes 6" x 6" rotary airlock for discharge of solid material*
  - *Also includes Griffin bin vent filter*

Major System Component Review

- *Ecomelt Dryer Induced Drat Fan (B-402)*
  - *Designed for 385 ACFM at 250° f flue gas exiting the Ecomelt dryer*
  - *Total static pressure of 10" W.G.*
  - *Carbon steel construction*
  - *Arrangement #9 configuration with 2 HP 1800 RPM drive motor*

Plant Start-Up Procedures/Initial Start-Up

- *Water Tanks*
  - *The inspection manways and doors should be removed to inspect the insides of the quencher water tank (T-301) and the granulator recirculation tank (T-203) to insure that no construction debris remain inside the equipment after erection and installation activities are complete. To the maximum practical extent possible, these tanks should be washed down with fresh water to minimize the possibility of plugging pumps, nozzles, etc. with undetected construction debris.*

Plant Start-Up Procedures/Initial Start-Up

- *Air Compressor (P-305) and Instrument Air Dryer*
  - *Start the compressor and allow unit to generate supply of compressed air. Start the plant air dryer by turning the switch to the "ON" position.*

Plant Start-Up Procedures/Initial Start-Up

- ***Ecomelt Generator (R-201), Secondary Combustion Chamber (R-202), and Granulator (C-203)***
  - ***Before operating the Ecomelt generator, all inspection manways and doors should be removed to inspect the inside of the rotary kiln, secondary combustion chamber (R-202), drop out box, melt section and granulator (C-203). Any construction debris remaining inside the equipment should be swept out after erection and installation activities are complete.***

Plant Start-Up Procedures

- ***Ecomelt Generator (R-201), Secondary Combustion Chamber (R-202), and Granulator (C-203)***
  - ***Inspect the stack cap assembly. Verify that the stack cap will open upon loss of power to solenoid valve PY-202. The exhaust mufflers on this solenoid valve should be adjusted for smooth stack cap operation. Tighten the mufflers all the way down to a closed position then open them 1/8th of a turn at a time, to adjust the speed at which the stack cap opens and closes (approximately 10-15 seconds to open or close).***

Plant Start-Up Procedures/Initial Start-Up

- ***Ecomelt Generator (R-201), Secondary Combustion Chamber (R-202), and Granulator (C-203)***
  - ***Inspect the rotary kiln trunnions and drive system for proper alignment and shimming. Start the rotation of the rotary kiln and continue observing the trunnions and drive system. Tighten the drive or shim the trunnions as necessary for a smooth operation. See Trunnion alignment standard operating procedures in Section XI.***

Plant Start-Up Procedures/Initial Start-Up

- ***Ecomelt Generator (R-201), Secondary Combustion Chamber (R-202), and Granulator (C-203)***
  - ***Check the granulator (C-203) for proper alignment and adjustments of the flights and chains. Retension the chains if necessary.***
  - ***Start the granulator (C-203) and observe the operation of the chains and flights. Shut down the system if any binding or jamming occurs. Make adjustments as necessary.***

Plant Start-Up Procedures/Initial Start-Up

- ***Quencher (Z-301), Baghouse (S-303), Activated Carbon Bed (A-304), and I.D. Fan (B-304)***
  - ***All inspection manways and doors should be removed to inspect the inside of these vessels, fans, and ductwork to insure that no construction debris remain inside the equipment after erection and installation activities are complete. To the maximum practical extent possible, the inside of these systems should be cleaned of all construction debris.***

Plant Start-Up Procedures/Initial Start-Up

- ***Quencher (Z-301), Baghouse (S-303), Activated Carbon Bed (A-304), and I.D. Fan (B-304)***
  - ***Start quencher double tipping valves (K-301 and KV-302) and verify tipping action.***
  - ***Start baghouse discharge rotary airlock feeder (F-303) and verify proper action. Once these systems have been checked out, they can be shut off.***
  - ***Close the inlet damper to the I.D. fan (PV-201).***
  - ***Start the I.D. fan (B-304) and check for proper rotation and function.***

Plant Start-Up Procedures/Initial Start-Up

- *Continuous Emissions Monitor (CEM)*
  - *Continuous emissions monitors are provided to monitor the discharge flue gas for opacity, carbon monoxide and oxygen at the final scrubber exhaust. These CEMS must be calibrated prior to system operation. The signals received from the CEMS for carbon monoxide and oxygen are used in the control and alarm functions of the PLC. The opacity blower should be turned on with the local start-stop hand switch (HS-105).*

Plant Start-Up Procedures/Initial Start-Up

- *Ecomelt Dryer (D-206) System*
  - *Inspect the rotary kiln trunnions and drive system for proper alignment and shimming. Start the rotation of the rotary kiln and continue observing the trunnions and drive system. Tighten the drive or shim the trunnions as necessary for a smooth operation. See trunnion alignment standard operating procedures in the FEECO operating manual.*

Plant Start-Up Procedures/Initial Start-Up

- *Ecomelt Product System*
  - *Start the wet Ecomelt rotary feeder (F-205) and verify proper action.*
  - *Start the wet granulated Ecomelt conveyor (C-205) and check for proper rotation and function.*
  - *Once these systems have been checked out, they can be shut off.*
  - *Start the dried Ecomelt bucket elevator (C-217) and verify proper action.*

Plant Start-Up Procedures/Initial Start-Up

- *Ecomelt Product System*
  - *Start the dried Ecomelt conveyor (C-216) and check for proper rotation and function.*
  - *Start the dryer discharge rotary feeder (F-206) and verify proper action.*
  - *Start the dryer cyclone dust discharge rotary feeder (F-401) and verify proper action.*
  - *Start the bag filter dust discharge rotary feeder (F-402) and verify proper action.*

Plant Start-Up Procedures/Initial Start-Up

- *Ecomelt Product System*
  - *Start the Ecomelt dryer induced draft fan (B-402) and verify proper rotation and function.*
  - *Start the Ecomelt product conveyor (C-219) and check for proper rotation and function.*
  - *Start the Ecomelt hopper discharge rotary feeder (F-219) and verify proper action.*
  - *Start the live bin bottom (V-219) and verify proper action.*

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Plant Start-Up Procedures/Initial Start-Up

- *Lime Eductor System*
  - *Start the lime feeder airlock (F-302A) and verify proper action.*
  - *Start the volumetric feeder (F-302) and check for proper rotation and function.*
  - *Start the live bin bottom (V-302) and verify proper action.*
  - **Start the lime eductor blower (B-302) and verify proper rotation and function**

Plant Start-Up Procedures/Initial Start-Up

- *Combustion Air and Nose Cooling Blowers*
  - *Close the Ecomelt Generator combustion air blower's discharge damper (AV-103).*
  - *Start the Ecomelt Generator combustion air blower (B-201) and verify proper rotation and function.*
  - *Close the secondary combustion chamber air blower's discharge damper (TV-133).*
  - *Start the secondary combustion chamber air blower (B-202) and verify proper rotation and function.*

Plant Start-Up Procedures/Initial Start-Up

- *Combustion Air and Nose Cooling Blowers*
  - *Close the melt section combustion air blower's discharge damper (TV-163).*
  - *Start the melt section combustion air blower (B-203) and verify proper rotation and function.*
  - *Close (manually) the Ecomelt Generator nose cooling blower's discharge damper.*
  - *Start the Ecomelt Generator nose-cooling blower (B-207) and verify proper rotation and function.*

Plant Start-Up Procedures/Initial Start-Up

- ***Combustion Air and Nose Cooling Blowers***
  - ***Completely open the discharge damper to the Ecomelt Generator nose cooling blower. The low pressure alarm "PAL-207" should clear.***

Plant Start-Up Procedures/Initial Start-Up

- ***Tank Filling and Leak Checking***
  - ***The access doors on the quencher water tank (T-301) and the granulator recirculation tank (T-203) should be closed.***

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Plant Start-Up Procedures/Initial Start-Up

- *Quencher Water Tank (T-301)*
  - *Fill the quencher water tank to its operating level.*
  - *Be sure all pump inlet and outlet block valves are open.*
  - *Turn on the quencher water pump (P-301) and check for proper rotation and function.*
  - *Check the entire quencher water piping throughout the plant for leaks and repair as required.*
  - *Fill the granulator recirculation tank to its operating level.*

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Plant Start-Up Procedures/Initial Start-Up

- *Granulator Recirculation Tank (T-203)*
  - *Once this tank has been filled to its proper operating level all pump inlet, seal flush and outlet block valves should be opened.*
  - *Start the granulator recirculation pump (P-203) and check for proper rotation and function.*
  - *Adjust the liquid flows to the weir and spray nozzles. Weir flow rate should be 120 GPM. The flow rate to the spray nozzles should be between 31 and 62 GPM.*

Plant Start-Up Procedures/Initial Start-Up

- *Granulator Recirculation Tank (T-203)*
  - *Check the entire granulator system piping for leaks and repair as required.*

Plant Start-Up Procedures/Initial Start-Up

- *Bin Vent Filters*
  - *Open the valve on the 4" fill line to modifier #1 hopper (T-103).*
  - *This should close the limit switch on the valve (ZSO-T103) which will energize the pulse timers (K-103).*
  - *Verify proper action and close the valve when finished.*
  - *Open the valve on the 4" fill line to the lime hopper (T-302).*

Plant Start-Up Procedures/Initial Start-Up

- ***Bin Vent Filters***
  - ***This should close the limit switch on the valve (ZSO-302) which will energize the pulse timers (K-302).***
  - ***Verify proper action and close the valve when finished.***

Plant Start-Up Procedures/Initial Start-Up

- ***Baghouse (S-303) and Bag Filter (S-402) Controls***
  - ***Pull the fuses to the baghouse and bag filter pulse timers in the main control panel (TS-1-11U and TS-1-12U).***
  - ***Open the baghouse and bag filter control panels (K-303 and K-402) and install alligator clipped jumper across the "pressure switch input" terminals.***
  - ***Install the fuse for the baghouse (TS-1-11U). This should start the pulse cleaning operation.***

Plant Start-Up Procedures/Initial Start-Up

- ***Baghouse (S-303) and Bag Filter (S-402) Controls***
  - ***Verify proper operation and remove the jumper when finished.***

Plant Start-Up Procedures/Initial Start-Up

- ***Modifier 1 and 2 Feed Systems***
  - ***Start the water-cooled auger/screw feeder (C-151). Verify correct rotation and function.***
  - ***Start the sediment/modifier mixer (M-131). Verify correct rotation and function.***
  - ***Start the vibe/belt feeder (F-104). Verify correct rotation and function.***
  - ***Start the live bin bottom (V-104) and verify proper function.***

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Plant Start-Up Procedures/Initial Start-Up

- *Modifier 1 and 2 Feed Systems*
  - *Once the belt feeder and live bin bottom have been checked out, they can be shut off. Do not shut off the water-cooled auger/screw feeder or the sediment/modifier mixer.*
  - *Start the vibratory feeder (F-103). Verify correct rotation and function.*
  - *Start the live bin bottom (V-103) and verify proper function.*

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Plant Start-Up Procedures/Initial Start-Up

- *Modifier 1 and 2 Feed Systems*
  - *Once the vibratory feeder and live bin bottom have been checked out, they can be shut off. Do not shut off the water-cooled auger/screw feeder or the sediment/modifier mixer.*

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Plant Start-Up Procedures/Initial Start-Up

- ***Raw Sediment Feed Systems***
  - ***Start the weigh screw feeder (C-112). Verify correct rotation and function***
  - ***Start the transfer conveyor (C-101). Verify correct rotation and function.***
  - ***Start the transfer conveyor (C-102). Verify correct rotation and function***
  - ***Start the alternate feed bin (screws) (T-102). Verify correct rotation and function.***

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Plant Start-Up Procedures/Initial Start-Up

- ***Raw Sediment Feed Systems***
  - ***Start the raw sediment storage bin (screws) (T-101). Verify correct rotation and function.***
  - ***Once these items have been checked out, they can be shut off. The water-cooled auger/screw feeder (C-151) and the sediment/modifier mixer (M-131) can also be shut off.***

Plant Start-Up Procedures/Initial Start-Up

- ***First Time Startup and Refractory Curing Procedures***
  - ***The quencher water tank (T-301) and the granulator recirculation tank (T-203) should be full of water and at their normal operating levels. All pump inlet, outlet and pipe rack valves must be open. The block valves for the pumps seal flush connection on the Ecomelt quencher water pump (P-203) must also be open.***

Plant Start-Up Procedures/Initial Start-Up

- ***First Time Startup and Refractory Curing Procedures***
  - ***All of the process controllers (except for the burner temperature controls) should be in automatic mode. The system should be started up in the exact sequence presented below. After starting up a pump, the operators should check the particular system for any problems and/or abnormalities.***

Plant Start-Up /Refractory Curing

- ***First Time Startup and Refractory Curing Procedures***
  - ***Turn on the quencher water pump (P-301).***
  - ***Adjust the water flow to the water cooled auger / screw feeder to 30 gpm.***
  - ***Turn on the Ecomelt quencher water pump (P-203).***
  - ***Adjust the liquid flows to the weir and spray nozzles. Weir flow rate should be 120 GPM. The flow rate to the spray nozzles should be between 31 and 62 GPM.***

Plant Start-Up /Refractory Curing

- ***Refractory Curing Precautions***
  - ***Always observe the refractory heat curing schedule before placing new thermal processing equipment into operation***
  - ***Do not subject the refractory to sudden temperature changes***
  - ***When the unit is started from an extremely cold condition, where moisture condensation can accumulate and wet the refractory, the temperature should be brought up at a slow rate of 75°F per hour.***

Plant Start-Up/Refractory Curing

- *Refractory Curing Precautions*
  - *If the unit is started from a preheated condition (250°F - 300°F), the temperature should be brought up at a rate not exceeding 100°F per hour.*

Plant Start-Up/Refractory Curing

- *Refractory Curing Precautions*
  - ***Do not use water in the thermal processing equipment to attempt to put out any fires. Steam can be used, but not water.***

Plant Start-Up/Refractory Curing

- *Refractory Curing Precautions*
  - *Do not use water in the thermal processing equipment to attempt to put out any fires. Steam can be used, but not water.*
  - *Do not subject the refractory to mechanical shock*
  - *Do not be alarmed by the appearance of random cracks in any monolithic lining*

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Plant Start-Up/Refractory Curing

- *Requirements Before Curing*
  - *Before curing the refractory, the thermal processing equipment, air cleanup, I.D. fans and water quenching systems must be fully operational. Andersen 2000 Inc. personnel, in accordance with the curing schedules, will conduct the refractory curing.*

Plant Start-Up/Refractory Curing

- *Ecomelt Generator System Preparation*
  - *Start the Ecomelt generator nose-cooling blower (B-207).*
  - *Start the I.D. fan (B-304).*
  - *Start the Ecomelt generator combustion air blower (B-201).*
  - *Start the afterburner combustion air blower (B-202).*
  - *Start the melt section combustion air blower (B-203).*
  - *Start the water-cooled auger/screw feeder (C-151).*

Plant Start-Up/Refractory Curing

- *Ecomelt Dryer System Refractory Curing*
  - *Start the dried Ecomelt bucket elevator (c-217)*
  - *Start the Ecomelt conveyor (C-216).*
  - *Start the dryer discharge rotary feeder (F-206).*
  - *Start the dryer cyclone dust discharge rotary feeder (F-401).*
  - *Start the bag filter dust discharge rotary feeder (F-402).*
  - *Start the Ecomelt Dryer induced draft fan (B-402).*
  -

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Plant Start-Up/Refractory Curing

- *Ecomelt Dryer System Refractory Curing*
  - *Start the Ecomelt Dryer drum (D-206)*
  - *Start the Ecomelt Dryer combustion air fan (B-206)*

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Plant Start-Up/Refractory Curing

- *Raw Sediment Feed*
  - *Start the sediment/modifier mixer (M-131).*
  - *Start the weigh screw feeder (C-112).*
  - *Start the transfer conveyor (C-101).*
  - *Set the flow controller FIC-101 to 0 #/hr.*
  - *Start the raw sediment storage bin (screws) (T-101).*
  - *Set the vibe/belt feeder (F-104) to automatic.*
  - *Start the live bin bottom (V-104).*

Plant Start-Up/Refractory Curing

- ***Raw Sediment Feed***
  - ***Set the vibratory feeder (F-103) to automatic.***
  - ***Start the live bin bottom (V-103).***
  - ***Change the set point of the flow controller FIC-101 to 500 #/hr. Slowly increase this to up to the maximum design flow rate of 3431.47 #/hr.***
  - ***Start the lime eductor blower B-302.***
  - ***Start the lime feeder airlock F-302A.***
  - ***Set the volumetric feeder (F-102) to automatic.***
  - ***Start the live bin bottom V-302.***

Plant Start-Up Procedures/Normal Start Up

- ***Air Compressor (P-305) and Instrument Air Dryer***
  - ***Start the compressor and allow unit to generate supply of compressed air. Start the plant air dryer by turning the switch to the "ON" position.***

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Plant Start-Up Procedures/Normal Start Up

- *Scrubbing System Preparation*
  - *The quencher water tank (T-301) and the granulator recirculation tank (T-203) should be full of water and at their normal operating levels. All pump inlet, outlet and pipe rack valves must be open. The block valves for the pumps seal flush connection on the Ecomelt quencher water pump (P-203) must also be open.*

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Plant Start-Up Procedures/Normal Start Up

- *Scrubbing System Preparation*
  - *All of the process controllers except the draft controller (PIC-201) should be in automatic mode. The draft controller (PIC-201) should be in manual at 0% output. This will close the I.D. Fan's inlet damper (PV-201). The set points for the burner temperature controllers (TIC-201, -202, -203 and -206) should be set to 200°F. The raw sediment flow controller (FIC-101) should be set to 0 #/hr.*

Plant Start-Up Procedures/Normal Start Up

- ***Scrubbing System Preparation***
  - ***Turn on the quencher water pump (P-301).***
  - ***Adjust the water flow to the water-cooled auger/screw feeder (C-151) to 30 gpm.***
  - ***Turn on the Ecomelt quencher water pump (P-203).***
  - ***Adjust the liquid flows to the weir and spray nozzles. Weir flow rate should be 120 GPM. The flow rate to the spray nozzles should be between 31 and 62 GPM.***

Plant Start-Up Procedures/Normal Start Up

- ***Scrubbing System Preparation***
  - ***Turn on the quencher water pump (P-301).***
  - ***Adjust the water flow to the water-cooled auger/screw feeder (C-151) to 30 gpm.***
  - ***Turn on the Ecomelt quencher water pump (P-203).***
  - ***Adjust the liquid flows to the weir and spray nozzles. Weir flow rate should be 120 GPM. The flow rate to the spray nozzles should be between 31 and 62 GPM.***

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Plant Start-Up Procedures/Normal Start Up

- *Scrubbing System Preparation*
  - *After starting up a pump, the operators should check the particular system for any problems and/or abnormalities.*

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Plant Start-Up Procedures/Normal Start Up

- *Ecomelt Generator System Preparation*
  - *Start the ID Fan*
  - *Place the draft controller (PIC-201) in automatic.*
  - *Start the Ecomelt Generator nose-cooling blower (B-207).*
  - *Start the Ecomelt Generator combustion air blower (B-201).*
  - *Start the secondary combustion chamber air blower (B-202).*

Plant Start-Up Procedures/Normal Start Up

- *Ecomelt Generator System Preparation*
  - *Start the melt burners combustion air blower (B-203).*
  - *Start the Ecomelt Generator drum drive (R-201).*
  - *Start the water-cooled auger / screw feeder (C-151).*

Plant Start-Up Procedures/Normal Start Up

- *Ecomelt Generator Warm-up*
  - *Light the kiln burner.*
  - *Light the afterburner.*
  - *Light the melt burners.*
  - *Start the quencher double tipping valves (KV-301 and KV-302).*
  - *Start the baghouse dust discharge rotary feeder (F-303).*

Plant Start-Up Procedures/Normal Start Up

- *Ecomelt Dryer System Warm-up*
  - *Start the dried Ecomelt bucket elevator (C-217).*
  - *Start the Ecomelt conveyor (C-216).*
  - *Start the dryer discharge rotary feeder (F-206).*
  - *Start the dryer cyclone dust discharge rotary feeder (F-401).*
  - *Start the bag filter dust discharge rotary feeder (F-402).*
  - *Start the Ecomelt dryer induced draft fan (B-402).*

Plant Start-Up Procedures/Normal Start Up

- *Ecomelt Dryer System Warm-up*
  - *Start the Ecomelt dryer drum (D-206).*
  - *Start the dryer combustion air fan (B-206).*
  - *Light the dryer burner.*

Plant Start-Up Procedures/Normal Start Up

- *Raw Sediment Feed*
  - *Start the sediment/modifier mixer (M-131).*
  - *Start the weigh screw feeder (C-112).*
  - *Start the transfer conveyor (C-101).*
  - *Start the raw sediment storage bin (screws) (T-101).*
  - *Set the vibe/belt feeder (F-104) to automatic.*
  - *Start the live bin bottom (V-104). Mod #2*
  - *Set the vibratory feeder (F-103) to automatic.*
  - *Start the live bin bottom (V-103). Mod .*

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Plant Start-Up Procedures/Normal Start Up

- *Raw Sediment Feed*
  - *Change the set point of the flow controller FIC-101 to 500 #/hr. Slowly increase this to up to the maximum design flow rate of 3431.47 #/hr.*
  - *Start the lime eductor blower B-302.*
  - *Start the lime feeder airlock F-302A.*
  - *Set the volumetric feeder (F-302) to automatic.*
  - *Start the live bin bottom V-302.*

Operational Guideline Review

- *Operating Temperature Ranges*
  - *Crucial operating parameters include the Ecomelt discharge temperature (2550°F), Ecomelt dryer outlet temperature (250°F), and baghouse inlet temperature (350°). If any of the above temperature ranges are not possible to achieve, contact Andersen 2000 Inc.*

Operational Guideline Review

- *Material Processing Rates*
  - *The plant has been designed to process up to 2,931#/hr of raw sediment. When mixed with the modifiers, the total waste and modifier feed rate will be up to 3431#/hr.*

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Operational Guideline Review

- ***Feed Rate Controller***
  - ***During initial startup, a correlation should be developed between the control output level of the modifier feeder variable speed controls and the actual modifier feed rate. This will provide the relationship between modifier feed signal and actual #/hr feed rate. This will provide the relationship between feeder control signal and the actual feed rate to the Ecomelt Generator in pounds/hour.***

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Operational Guideline Review

- ***Beginning Feed to the Ecomelt Generator***
  - ***Raw sediment feed must not be introduced into the Ecomelt generator until the Ecomelt generator, melt section and secondary combustion chamber have been properly pre-heated to their required operational temperature and the quench system fully operational.***

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Operational Guideline Review

- *Ecomelt Generator Rotational Speed*
  - *Rotational speed of the ECOMELT GENERATOR is controlled and altered by using the control for the variable speed drive. The operational rotation is expected to be 0.2-1.0 rpm. The required rotational speed is a function of the rate of materials processing, temperature, and material type. The recommended initial starting point for the Ecomelt Generator is 0.7 rpm.*

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Operational Guideline Review

- *Ecomelt Generator Rotational Speed*
  - *The unit can be operated with the burner output level held constant while using the feed rate and the Ecomelt generator rotational speed controllers to alter and track the outlet temperatures. This helps to fine-tune the process.*

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Operational Guideline Review

- *Ecomelt Generator Warm-Up*
  - *During start-up, care should be taken to assure that the system is not heated too quickly as the components and ductwork will absorb heat and expand slightly. The Ecomelt generator exhaust gas temperature should be elevated from ambient temperature at a rate of 100°F per hour*

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Operational Guideline Review

- *Ecomelt Generator - Draft*
  - *During operation, the system draft should be modulated as necessary to maintain a burner suction of -0.2 to -0.3 inches water column as indicated on the "PIC-201" indicator. This suction is measured by a dP cell which monitors pressure at the port located at the burner end plate, left of the Ecomelt Generator burner. Too low of burner suction draft will cause overheating of drum shell and "puff back" through drum seals.*

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Operational Guideline Review

- *Ecomelt Generator - Draft*
  - *A low draft is desirable from the standpoint of minimizing the volume of airflow through the system, thus maximizing production rate capacity. Too high of a draft will cause more excess air than necessary to be pulled in through the drum seals. This will contribute to an inefficient process and production rate limitations. The Ecomelt Generator must be kept under a slight negative draft at all times, as described above.*

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Operational Guideline Review

- *Material Discharge Temperature*
  - *The temperature selected for material processing has been determined by ECH. However, the unit should be operated with the lowest temperature found to slag (melt) the raw sediment and modifier mixture. Another parameter that will have an effect on the material processing is drum speed. The rational speed of the drum can be used to retard the advancing motion of the material and increase retention time.*

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Operational Guideline Review

- *Ecomelt Quencher and Granulator*
  - *The material cooling water injection system consists of a pipe lance fitted with five (5) spray nozzles and four (4) plugged couplings. The total number of nozzles can be changed as required to solidify the slagged material as it drops into the granulator conveyor. Total liquid flow to the spray nozzles can be adjusted with a valve in the feed piping. Two rotameters have been provided to monitor the water flow to the spray nozzles and the overflow weir.*

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Operational Guideline Review

- *Secondary Combustion Chamber Warm-Up*
  - *During start-up, care should be taken to assure that the system is not heated too quickly. The secondary combustion chamber exit gas temperature should be elevated from ambient temperature at a rate of 100°F per hour. As the secondary combustion chamber burner level is changed, the system draft will be affected and should be adjusted to maintain a burner suction of -0.2 to 0.3 inches water column as indicated on the "PIC-201" indicator.*

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Operational Guideline Review

- ***Secondary Combustion Chamber Temperature Variations***
  - ***During operation, vaporized contaminants will be received by the secondary combustion chamber where they are oxidized by the elevated temperatures. When the contaminants oxidize, energy is released which will add to the energy being supplied by the secondary combustion chamber burner.***

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Operational Guideline Review

- ***Secondary Combustion Chamber Temperature Variations***
  - ***As the concentration of these vaporized contaminants changes, temperature swings will occur which will be compensated for by the secondary combustion chamber burner controller, when in the automatic control mode. If the burner control system is not in the automatic control mode, the operator must monitor the secondary combustion chamber outlet temperature and adjust the burner output accordingly.***

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Operational Guideline Review

- ***Secondary Combustion Chamber Temperature Variations***
  - ***As operator skill is gained, along with knowledge of material conditions, temperature swings will be minimized in the secondary combustion chamber.***

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Operational Guideline Review

- ***Oxygen / Contaminant Oxidation***
  - ***Changes in the Ecomelt Generator combustion air supply may be necessary to assure that enough oxygen is available for contaminant oxidation when high contaminant levels are being processed. This can be achieved by altering the position of the Ecomelt Generator combustion air damper (AV-103).***

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Operational Guideline Review

- *Oxygen / Contaminant Oxidation*
  - *This adjustment is done by the combustion air damper controller "FY-103". The minimum oxygen content of the gas stream exiting the Ecomelt Generator should generally be in the range of 2.5 to 3%.*

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Operational Guideline Review

- *Quencher Exit Temperature*
  - *The system cooling chamber serves to reduce the temperature of the gases entering the baghouse. The critical parameter associated with the cooling chamber is the baghouse inlet temperature. The exit temperature of the Quencher should be 350° not to exceed 400°F and should be monitored for cooling system performance.*

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Operational Guideline Review

- *Quencher Nozzle Inspection*
  - *Periodic inspection of the injection nozzles should be performed on a regular basis along with manual cleaning to remove deposits, when needed. Excessive material build-up in the Quencher chamber can be the result of a reduction in the degree of atomization of the quench water. When good atomization is not achieved, the water droplets may not be fully evaporated by the time the spray pattern contacts the chamber walls.*

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Operational Guideline Review

- *Quencher Nozzle Inspection*
  - *If the water spray contacts the chamber walls, material build-up will result.*
  - *Extreme care should be exercised when cleaning accumulations from the interior of the Quencher chamber due to the possibility of materials breaking loose from the upper portion and falling on personnel working in the lower portion.*

Operational Guideline Review

- ***Baghouse Inlet Temperature***
  - ***There are several critical parameters associated with operation of the baghouse. The most important of these is the gas inlet temperature to the baghouse which must not exceed 400°F.***

Operational Guideline Review

- ***Baghouse Exit Temperature***
  - ***The baghouse should be operated so the exit gas temperature does not fall below around 335°F. This is particularly important when processing materials containing either halogenated or sulfided compounds since these materials will tend to condense out of the gas stream and cause corrosion of the interior surfaces of the baghouse, duct, fan and stack.***

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Operational Guideline Review

- ***Baghouse Pressure Differential***
  - ***The operator should monitor the baghouse pressure drop which is the pressure differential across the tubesheet. This pressure will vary across a specified range which activates the pulse-jet cleaning system. The pressure drop across the tube sheet should typically run at 6 inches water column. The air pressure for this system should be 80-95 psi in the baghouse cleaning manifold.***

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Operational Guideline Review

- ***Testing for Baghouse Leaks***
  - ***To assure that there are no leaks in the baghouse, blacklight dust can be distributed into the baghouse. After distributing the dust and operating the draft fan for a short period of time, stop the fan and open the top access doors. This allows access to the clean side of the tube sheet which can then be checked, using a blacklight, for signs of the dust.***

Operational Guideline Review

- *Testing for Baghouse Leaks*
  - *This method is used to identify leaking bags, improperly seated bags, and/or leaks in sidewalls. This should always be done prior to a stack test and whenever there is a concern that the expected particulate collection efficiency is not being achieved.*

Operational Guideline Review

- *Lime Injection System*
  - *The lime injection system should be checked for pluggage or loss of lime flow. If the pipe lines are plugged, the pipes would rapidly cool off, which could be checked by a surface thermometer. The only way to determine lime bridging is to monitor the lime hopper level indicator (LI-302) over a long period of time. No change or very little change would indicate lime bridging or pluggage.*

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Operational Guideline Review

- *Activated Carbon Bed*
  - *The activated carbon bed is a passive system with no operator involvement. The vessel should be visually checked with an IR gun to check for hot spots.*

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Operational Guideline Review

- *Air Compressor*
  - *The general pressure ranges for the main compressed air functions are listed below:*
  - *Air Operated Control Valves 20-25 psig*
  - *C.E.M. 80 psig*
  - *Opacity 70-100 psig*
  - *Quencher Atomizing Air (PCV-304 set @ 50 psig) 40 psig at nozzles*
  - *Baghouse Cleaning Air 80-95 psig*
  - *Bin Vent Filters Cleaning Air 80-95 psig*

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Shutdown Procedures/Normal Shutdown

- *Normal Shutdown*
  - *Stop raw sediment feed by turning off either the raw sediment storage bin (screws) (T-101 or the alternate feed bin (screws) (T-102).*
  - *Stop the vibratory feeder (F-103) and the live bin bottom (V-103) for the modifier 1 hopper.*
  - *Stop the vibe/belt feeder (F-104) and the live bin bottom (V-104) for the modifier 2 hopper.*

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Shutdown Procedures/Normal Shutdown

- *Normal Shutdown*
  - *The operator must now wait until the material from all of the screw conveyors has been emptied. When the weigh screw feeder flow indicator (WIT-112) shows "0#/hr", the operator can proceed.*
  - *Stop the transfer conveyor (C-102) if it was running.*
  - *Stop the transfer conveyor (C-101).*
  - *Stop the weigh screw feeder (C-112).*

Shutdown Procedures/Normal Shutdown

- *Normal Shutdown*
  - *Stop the modifier 1 conveyor (C-103).*
  - *Wait 5 minutes or until no more material is being fed into the Ecomelt Generator and then stop the sediment/modifier mixer (M-131). The operator can listen for a change in the noise emanating from the equipment which would indicate no material flow. This should be verified visually through the view port at the discharge end of the Ecomelt Generator.*

Shutdown Procedures/Normal Shutdown

- *Normal Shutdown*
  - *The primary, afterburner and melt burners should still all be in automatic. The temperature set points for each burner should be slowly reduced. The ideal cooling rate is 100°F per hour.*
  - *The Ecomelt dryer system will also have to be shut down. Shut down procedures for this system starts at instruction #23.*
  - *Stop the volumetric feeder (F-302), the live bin bottom (V-302) and the lime feeder airlock (F-302A).*

Shutdown Procedures/Normal Shutdown

- *Normal Shutdown*
  - *Stop the lime eductor blower (B-302).*
  - *Once the temperature entering the quencher (Z-301) is below 300°F, the primary, afterburner and melt burners should be turned off.*
  - *Turn off the burner combustion air fans B-201, B-202 and B-203.*
  - *Turn off the induced draft fan B-304.*
  - *Turn off the double tipping valves KV-301 and KV-302 and the dust discharge rotary feeder F-303.*

Shutdown Procedures/Normal Shutdown

- *Normal Shutdown*
  - *Once the temperature inside the Ecomelt Generator has dropped below 190°F, the water-cooled auger/screw feeder (C-151), the nose cooling blower (B-207) and the Ecomelt Generator drive (R-201) can be turned off.*
  - *Stop the Ecomelt quencher water pump (P-203) and the quencher water pump (P-301).*
  - *Turn off the opacity blower.*

Shutdown Procedures/Normal Shutdown

- *Normal Shutdown*
  - *Turn off the C.E.M. and drain all the water from the condenser inside the enclosure if the ambient temperature will get below freezing.*
  - *Turn off the air compressor (P-305), vent the compressed air and drain the receiver tank (T-305).*

Shutdown Procedures/Normal Shutdown

- *Normal Shutdown*

  - *Eventually, no more material will be processed through the Ecomelt Generator and into the granulator. As the material feed into the dryer is decreased, the dryer burner firing rate will be decreased. When the combustion chamber temperature drops below 250°F, the burner can be turned off.*

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Shutdown Procedures/Normal Shutdown

- *Normal Shutdown*
  - *When all of the material has been removed from the dryer drum, it can be turned off.*
  - *Stop the Ecomelt Dryer induced draft fan (B-402).*
  - *Stop the Granulator (C-203).*
  - *Stop the wet granulated Ecomelt conveyor (C-205).*
  - *Stop the wet Ecomelt rotary feeder (F-205).*
  - *When all of the material has been removed from the dried Ecomelt conveyor C-216 and the the rotary feeders.*

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Shutdown Procedures/Normal Shutdown

- *Normal Shutdown*
  - *Stop the dried Ecomelt conveyor C-216.*
  - *When the dried Ecomelt bucket elevator is empty, it can be stopped.*

Shutdown Procedures/Power Failure

- *Power Failure Shutdown*
  - *Start the quencher water pump (P-301) and the Ecomelt quencher water pump (P-203).*
  - *Start the Ecomelt Generator combustion air blower (B-201).*
  - *Start the Ecomelt Generator nose-cooling blower (B-207).*
  - *Start the rotary kiln drive (R-201).*
  - *Start the granulator (C-203).*

Shutdown Procedures/Alarms

- *Alarm Shutdown*
  - *If an emergency occurs with any of the equipment due to mechanical failure and/or an alarm condition, the PLC control system initiates an automatic shutdown of the appropriate burner or the equipment associated with the failure. The cause for this shutdown should, therefore, be immediately investigated. Tips for troubleshooting the system are provided in Section XVI. The operator should not simply reset an alarm to restart the system.*

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Shutdown Procedures/Alarms

- *Alarm Shutdown*
  - *The cause and source of the alarm should be fully investigated and corrected prior to restarting the system.*

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Shutdown Procedures/Alarms

- *Alarm Shutdown*
  - *The cause and source of the alarm should be fully investigated and corrected prior to restarting the system.*

Shutdown Procedures/Emergency Stop

- *Emergency Stop*
  - *Only under extreme emergency conditions should this shutdown procedure be used. The entire incineration and scrubbing system can be shutdown by pushing the "Emergency Stop" pushbutton on the local panel.*

Shutdown Procedures/Emergency Stop

- *Emergency Stop*

  - *If the system is stopped in this condition for an extended period, it is quite likely that the kiln will experience thermal damage since it does not continue to rotate. Therefore, it is important that the kiln drive motor be reactivated as soon as possible so that the kiln does not remain in a static condition. This can also create some rather serious problems with clinker buildup in the kiln and with a number of other conditions which should be avoided except in extreme emergencies.*

Safety Review

- ***THE COMPLETE OBSERVANCE OF ONE SIMPLE RULE WOULD PREVENT MANY THOUSANDS OF SERIOUS ACCIDENTS EACH YEAR.***

Safety Review

THAT RULE IS:

Never Attempt to Clean, Oil, or Adjust any Machine or Machine Part Unless it is Stopped and Properly Locked Out with Your Personal Padlock to Insure that the Machine Cannot be Inadvertently Restarted.

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Safety Review

- *Safety Review*
  - *KEEP AWAY from power driven parts unless they are properly locked out and rendered inoperative. Lock out power (unless instructed differently in this manual) before working on or near equipment for any reason. Use extreme caution if you must approach powered equipment.*
  - *ALWAYS USE normal start-up, operating and shutdown procedures as listed in this manual.*

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Safety Review

- *Safety Review*
  - *BE SURE the machine is in good operating condition and that all safety devices are installed and functioning properly.*
  - *KEEP items such as shirt sleeves, shirt tails, and long hair properly confined. Avoid wearing items such as wrist watches, rings, necklaces, and neckties.*
  - *WEAR personal protective equipment appropriate to the job conditions.*

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Safety Review

- *Safety Review*
  - *ACCOUNT for each person before starting any equipment. Use start-up alarm.*
  - *KEEP all spectators and other workers away from equipment while in operation.*
  - *DO NOT ALLOW people in areas where material might fall on them (e.g. under discharge points, under bypass chutes, near conveyors).*

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Safety Review

- *Safety Review*
  - *ALLOW only responsible, owner authorized, properly instructed individuals to operate the equipment. Carefully supervise inexperienced operators. New operators should be properly trained and supervised.*

Safety Review

- *Safety Review*
  - *ALLOW only responsible, owner authorized, properly instructed individuals to operate the equipment. Carefully supervise inexperienced operators. New operators should be properly trained and supervised.*
  - *DO NOT ADJUST MOVING EQUIPMENT while operating. Use lockout procedures when maintenance or adjustments must be performed on moving equipment.*

Safety Review

- *Safety Review*
  - *NEVER leave the Control Station unattended when any equipment is running.*
  - *MAKE NO MODIFICATIONS to your equipment unless specifically recommended or requested by Andersen 2000 Inc.*
  - *NEVER defeat the safety features of this equipment. (e.g. Never jumper around interlocks.)*
  - *AVOID suffocation. Do not walk on material in Feed Bins, as material surfaces might collapse.*

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Safety Review

- *Safety Review*
  - *DO NOT ENTER PTU drum, breechings, STU chamber or other confined spaces without adhering to approved procedures for entering confined areas without breathable atmosphere.*
  - *USE precautions for flammable materials.*
  - *Stay on designated work platforms to avoid falls. If work must be done in other areas use appropriate safety belts or other equipment.*

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Safety Review

- *Safety Review*
  - *AVOID high-pressure fluids. (e.g. hydraulic fluid/air). Escaping fluid under pressure can penetrate the skin causing serious injury. Relieve pressure before disconnecting hydraulic or other lines. Tighten all connections before applying pressure. Keep hands and body away from pin holes and nozzles which direct fluids under high pressure. Use a piece of cardboard or paper to search for leaks. Do not use you hand.*

Safety Review

- *Safety Review*
  - *DO NOT ALLOW people in areas where hot surfaces and/or radiated heat might present a safety hazard. Be extremely careful around material feed and discharge chutes. These can cause injury if contact is made with hot materials and/or hot surfaces. Being near the material feed and discharge openings is extremely dangerous if flammable conditions are created within the process. Dangerous conditions can be encountered without warning.*

Safety Review

- *Safety Review*
  - *CHECK the legibility of all safety signs every day; order new signs if they need to be replaced.*

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Equipment Lubrication

- *Importance of Lubrication*
  - *Nothing can add to the life of the system more than thorough lubrication of the moving parts, properly executed at the correct intervals. When time and availability of the machine are at a premium, it is absolutely inexcusable to have a breakdown resulting from improper lubrication, since this can so easily be avoided.*
  - *A normal lubrication schedule should be established for all the equipment components in this system.*

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Equipment Lubrication

- *ANTI-FRICTION BEARINGS*
  - *The anti-friction bearings used on the support system have been lubricated at the factory. The grease cannot be seen since it is concealed within the bearing by the grease retainer seals.*
  - *Over-greasing distorts and damages these seals allowing dirt to enter and greatly shorten the life of the bearing.*
  - *NOTE: Never use a power operated grease gun on anti-friction bearings.*

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Equipment Lubrication

- ***LOCAL ASSISTANCE***
  - ***At the site of operation, identify local petroleum suppliers and contact them for guidance on available lubricants. Refer to the lubrication chart in this section for specific lubricant requirements.***

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Equipment Lubrication

- ***General Lubrication Procedures***
  - ***Keep all grease guns clean and wipe grease fittings with a clean cloth to prevent grit from being pumped into the bearings.***
  - ***Keep all grease and oil containers clean with their covers in place (except when using) to keep dust and dirt out of the lubricant.***
  - ***Keep each lubricant container well labeled and make no mistake in using the correct lubricant in the right places.***

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Equipment Lubrication

- *General Lubrication Procedures*
  - *Study all lubrication charts and instructions. Do not guess when lubricating any component. Call the manufacturer, if necessary.*
  - *Keep all components as clean as possible and remove any excess grease and oil which may accumulate during the day.*
  - *When lubricating ball or roller bearings be extremely careful not to rupture the bearing seals through over-greasing.*

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Equipment Lubrication

- *Access to Lubrication Points*
  - *In some cases, it can be advantageous to "customize" a plant by attaching copper tubing to the grease fittings common to a particular area and running them to an easily accessible area. This creates a lubrication point "bundle" which can simplify the lubrication procedure. This procedure can reduce access problems.*

Kiln and Support Trunnion Alignment

- ***Trunnion Alignment Procedures***
  - ***This section will discuss the recommended steps for setting up a rotary kiln incinerator and adjusting the support trunnions. There are many theories and designs for these equipment items, each having their own special requirements, advantages or shortcomings. For this reason, we have included the following discussion of the major components and the terms that we will use to describe them.***

Drive Belts

- ***Refer to Section XII of the Operating Manual***

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Chains and Spockects

- *Refer to Section XIII of the Operating Manual*

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I.D. Fans and Blowers

- *Fan Inspection*
  - *Inspect the induced draft fan and burner combustion air blowers periodically during operation, whenever unusual noise or vibration is detected, and before start-up following an extended shut-down. Check for material accumulation, corrosion, worn or loose parts, and/or water accumulation in housing. Monitor the induced draft fan for accumulations of condensed oils.*

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I.D. Fans and Blowers

- *FAN VIBRATION*
  - *Build up of dust or foreign matter on the wheel.*
  - *Loose bolts on bearings, housing and drive.*
  - *V-belt drives improperly aligned or tensioned, or sheaves not in balance.*
  - *Bearing clearance and/or improper alignment.*
  - *Fan wheel loose on its shaft.*

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I.D. Fans and Blowers

- *FAN VIBRATION*
  - *Fan wheel, shaft or bearings damaged (possibly by foreign matter entering the fan).*
  - *Fan wheel shifting on its shaft, resulting in improper clearances.*

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I.D. Fans and Blowers

- *Other Sources of Vibration*
  - *Can vibrations be attributed to a flittering damper?*
  - *Does the vibration continue when the drive belts are removed and the motor is run by itself?*
  - *Does the vibration continue when the fan is stopped?*

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I.D. Fans and Blowers

- *Prolonged Shutdown*
  - *If the draft fan and burner blowers are to remain idle for an extended period, protect exposed surfaces with a suitable coating. Rotate the shafts periodically to prevent corrosion in the bearings. Remove drain plugs to prevent water or other condensate from accumulating in the housings. Cover any inlets and/or outlets which could be exposed to rain infiltration.*

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Equipment Inspection and Maintenance

- ***Required Equipment***
  - ***A 30" H_2O differential pressure gauge with flexible tubing to both high and low pressure ports.***
  - ***A 0-60 psig pressure gauge with Type 316 S.S. Bourdon tube.***
  - ***A digital multimeter with current transformer accessory to enable amperage readings on running motors.***
  - ***A vibration detector and analyzer.***

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Equipment Inspection and Maintenance

- ***Required Equipment***
  - ***A surface temperature thermocouple and indicator with 0-500 range.***
  - ***A "gun type" I.R. temperature reading instrument.***
  - ***Adequate supply of pH buffer solutions (pH = 4 and 7)***

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Equipment Inspection and Maintenance

- *Daily Maintenance*
  - *Kiln, Afterburner, Drop Out Box, Ducts and Quencher. Using the I.R. gun-type heat detector, verify the surface temperatures of these items. Visually check through the site glass at the end of the kiln and secondary combustion chamber and on both sides of the melt section burners to insure that the refractory has not been damaged and to insure that there are no clinker buildups or slag buildups.*

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Equipment Inspection and Maintenance

- *Daily Maintenance*
  - *Granulator. In conjunction with the inspection of the rotary kiln melter, the product from the granulator should be checked. Ecomelt Generator operating parameters may have to be adjusted to change the quality or quantity of the Ecomelt product. These parameters are temperature, drum speed, sediment feed rate, and modifier feed rates.*

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Equipment Inspection and Maintenance

- *Daily Maintenance*
  - *Water Quenching Systems. Verify the liquid flows to the water cooled auger/screw feeder (C-151) and to the weirs and spray nozzles in the melt section.*

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Equipment Inspection and Maintenance

- *Daily Maintenance*
  - *PLC and CEM Systems. Review all PLC setpoints from the console and verify that all alarms and annunciators are functioning properly. Check all temperature, pressure, and flow set points on the PLC system. Review the alarm log and report any alarms which must be reported to the regulatory agency. This would include excursions recorded by the CEM system or temperature or pressure alarms in the PLC system.*

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Equipment Inspection and Maintenance

- *Daily Maintenance*
  - *PLC and CEM Systems. Check also to be sure that the CEM is functioning properly and that the daily calibration values are recorded.*

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Equipment Inspection and Maintenance

- *Daily Maintenance*
  - *Quencher (Z-301). Verify the liquid flow rates to the spray nozzles. Check to be sure that the double tipping valve below the cone is operating properly and is not plugged.*

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Equipment Inspection and Maintenance

- *Daily Maintenance*
  - *Baghouse (S-303). Visually inspect the cladding and insulation and repair any damage found. Check to be sure that the discharge valve is operating properly and is not plugged. Check the differential pressure across the unit and verify that the cleaning cycle is working properly.*

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Equipment Inspection and Maintenance

- *Daily Maintenance*
  - *Activated Carbon Bed. Using the I.R. gun-type heat detector, check the surface temperature. Verify that there is fire water supply to the emergency quench nozzles in this vessel.*

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Equipment Inspection and Maintenance

- *Daily Maintenance*
  - *I.D. Fan and Lime Eductor Blower. Check these fans for vibration using a vibration analyzer. Check the fan bearing temperatures using a surface temperature detector. Please note that over-lubrication of the bearings causes excessive temperature. If temperatures are excessive, do not lubricate the bearings until it has been verified that they do not have adequate lubricant in them.*

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Equipment Inspection and Maintenance

- *Daily Maintenance*
  - *Combustion Air Fans and Nose Cooling Fan. Check these fans for excessive vibration.*
  - *Ecomelt Dryer. Using the I.R. gun-type heat detector, check the surface temperature of the combustion chamber and the drum.*

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Equipment Inspection and Maintenance

- *Daily Maintenance*
  - *Bag Filter. Check to be sure that the discharge valve is operating properly and is not plugged. Check the differential pressure across the unit and verify that the cleaning cycle is working properly.*
  - *Ecomelt Dryer Induced Draft Fan. Check this fan for excessive vibration.*

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Equipment Inspection and Maintenance

- *Weekly Maintenance*
  - *Kiln, Afterburner, and Cyclone. Verify that all air supply fan intake filters or screens are opened and cleaned. Check the entire kiln shell and afterburner shell for hot spots which would indicate refractory problems. Check the seals at the feed end and discharge end of the kiln for leakage and wear. If there is substantial wear on the wear materials, schedule a replacement at the earliest possible opportunity.*

Equipment Inspection and Maintenance

- *Weekly Maintenance*
  - *Check the kiln tires and the four kiln trunnions for wear which would indicate kiln misalignment. If there is substantial wear occurring, realign the kiln in accordance with the procedures described in Section XI. Check the kiln drive chain to insure that it is being lubricated routinely and correctly. Check the high temperature expansion joint in the ducting from the afterburner to the quencher to insure that it has not been damaged and to insure that it is not leaking.*

Equipment Inspection and Maintenance

- *Weekly Maintenance*
  - *Burners. Verify all burner safety functions from the burner safety panels. There is a separate burner safety panel for each burner area.*
  - *Air Pollution Control System. Calibrate the pH electrode in the granulator recirculation loop.*
  - *Check all pressure gauges to verify that nozzles are not plugged.*

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Equipment Inspection and Maintenance

- *Weekly Maintenance*
  - *PLC and CEM Systems. Check to insure that there is adequate calibration gas available for the next week. Clean all traps and filters in the gas cleanup system for the CEM. Verify that all CEM probes in the system are clean and functioning properly.*

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Equipment Inspection and Maintenance

- *Monthly Maintenance*
  - *Do a detailed examination of all external surfaces of refractory lined equipment for signs of refractory failure and then do a detailed visual inspection through the sight ports of the refractory condition throughout the system. If refractory damage has occurred to the point that repairs are necessary, the system will have to be shut down for refractory repairs.*

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Equipment Inspection and Maintenance

- ***Monthly Maintenance***
  - ***Calibrate all instruments in all component parts of the system, including thermocouples.***

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Equipment Inspection and Maintenance

- ***Monthly Maintenance***
  - ***Check all metal components of the system for signs of corrosive damage. If corrosion is beginning to occur, clean and repaint the corroded areas. If temperature damage is noted, schedule a replacement of the temperature damaged area and repair the cause of the temperature damage.***
  - ***Verify structural integrity of all supports, platforms, hand rails, toe plates, and guards and be sure that all fasteners are tight.***

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Equipment Inspection and Maintenance

- *Monthly Maintenance*
  - *Verify that all limit switches on all equipment items are functioning properly and are properly adjusted.*

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Equipment Inspection and Maintenance

- *Monthly Maintenance*
  - *The drive chains for the following equipment should be oiled on a monthly basis.*
    - *Alternate Feed Bin Agitator (T-102)*
    - *Granulator (C-203)*
    - *Wet Ecomelt Rotary Feeder (F-205)*
    - *Dried Ecomelt Rotary Feeder (F-206)*
    - *Dryer Cyclone Dust Discharge Rotary Feeder (F-401)*

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Equipment Inspection and Maintenance

- *Monthly Maintenance*
  - *The drive chains for the following equipment should be oiled on a monthly basis.*
    - *Bag Filter Dust Discharge Rotary Feeder (F-402)*
    - *Baghouse Dust Discharge Rotary Feeder (F-303)*
    - *Lime Feeder Air Lock (F-302A)*
    - *Ecomelt Hopper Rotary Feeder (F-219)*

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Equipment Inspection and Maintenance

- *Annual Maintenance*
  - *Kiln, Afterburner and Dryer. Open all access doors and provide ventilation to completely purge the system with ambient air. Enter the inspection doors and inspect all internal surfaces of the entire system. Check for refractory damage and repair any refractory damage. Check all expansion joints and repair the expansion joints if they have been damaged.*

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Equipment Inspection and Maintenance

- *Annual Maintenance*
  - *Check that the stack cap bearings are properly lubricated and that the stack cap is operating properly. It will be necessary to measure the force required to open the stack cap and to adjust the quantity of ethylene glycol-water in the trim tank to insure that the cap opens at the proper positive pressure.*

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Equipment Inspection and Maintenance

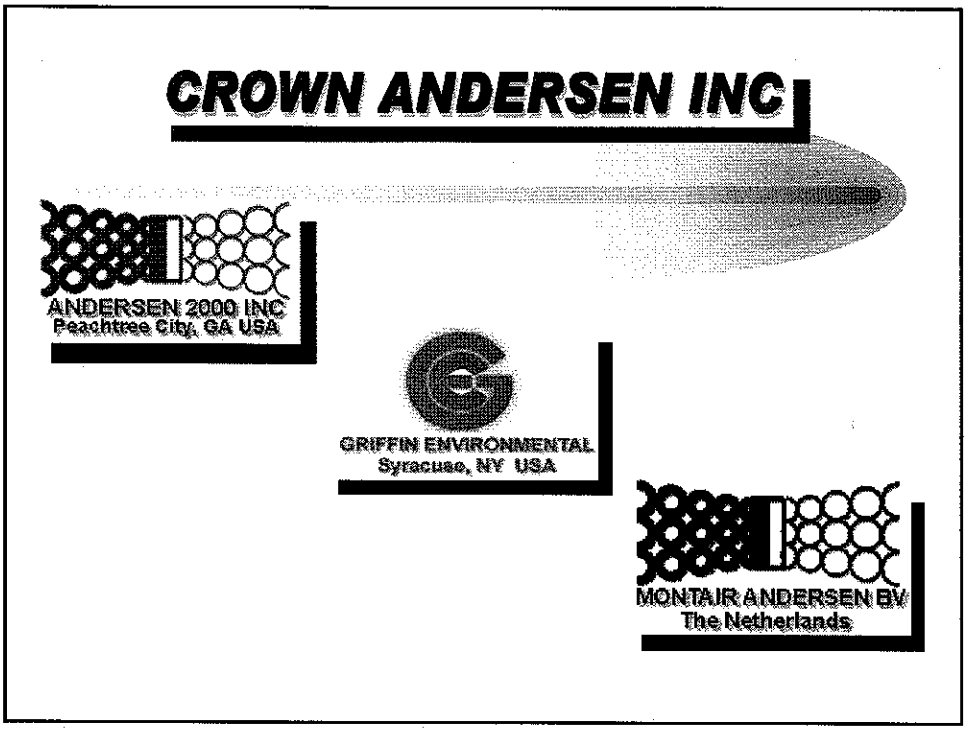
- *Annual Maintenance*
  - *Also verify that the refractory lining in the stack cap is completely intact. Remove the cover plates from the rotary valve below the baghouse and clean the valve. If abnormal wear has occurred on the valve plates or seals, replace them. Open up the granulator and check for solids buildup, wear on any of the guide mechanism, chain wear, flight wear, bottom wear, or sprocket wear. Replace any worn components.*

Equipment Inspection and Maintenance

- ***Annual Maintenance***
  - ***Clean all fuel supplied trains to the burners, clean the burner nozzle tips, and clean the burner refractory tiles. If necessary, replace any heat damaged components on the burners.***

Troubleshooting

- ***Refer to Troubleshooting Guide in Section XVI of the Operating and Maintenance Manual***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